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LEVEL II

LOWER HUDSON RIVER WATERSHED
RAMAPO RIVER BASIN

LAKE KANAWAUKE DAM
ROCKLAND COUNTY, NEW YORK

NY 58
PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

Prepared by
JOSEPH S. WARD & ASSOCIATES
CONSULTING ENGINEERS
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DACW51-78-C-0035

For

DEPARTMENT OF THE ARMY
NEW YORK DISTRICT, CORPS OF ENGINEERS
26 FEDERAL PLAZA
NEW YORK, NEW YORK 10007

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    This report provides information and analysis on the physical condition of the dam as of the report date. Information and analysis are based on visual inspection of the dam by the performing organization.

    Lake Kanawauke Dam was judged to be safe, although several maintenance recommendations were made.

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LOWER HUDSON RIVER WATERSHED
RAMAPO RIVER BASIN
ROCKLAND COUNTY, NEW YORK

LAKE KANAWAUKE DAM
PALISADES INTERSTATE PARK COMMISSION
NDS # NY 58
NYSDEC # 196A-353

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

Prepared by

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For

DEPARTMENT OF THE ARMY
New York District, Corps of Engineers
26 Federal Plaza
New York, New York 10007

21 July 1978

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NATIONAL DAM SAFETY PROGRAM

BRIEF ASSESSMENT OF GENERAL CONDITION

AND

RECOMMENDED ACTION

Name of Dam: Lake Kanawauke Dam

Owner: Palisades Interstate Park Commission (PIPC)

State Located: New York

County Located: Rockland

Stream: Stony Brook, a tributary of Ramapo River

Dates of Inspection: 22 June 1978; 7 July 1978

Inspection Team: Joseph S. Ward and Associates
91 Roseland Avenue, P. O. Box 91
Caldwell, New Jersey 07006

and

Lev Zetlin and Associates, Inc.
95 Madison Avenue
New York, New York 10016

Based on our visual inspections, a review of the limited available data, and calculations performed as part of this study, the Lake Kanawauke Dam is judged to be in generally good condition and functioning satisfactorily at this time. The spillway will not pass the Probable Maximum Flood (PMF) without the dam being overtopped. Therefore, based on the screening guidelines established by the Department of Army, Office of the Chief of Engineers (OCE), the spillway capacity is rated as inadequate. According to our computations, however, the existing spillway can pass a flood with a peak inflow of approximately 50 percent of the PMF flow. Therefore, the spillway capacity is not considered to be seriously inadequate based on the OCE guidelines for determining seriously inadequate spillway capacity.

Our assessment of the general condition of the Lake Kanawauke Dam has led us to make the following recommendations which should be implemented as soon as practicable; items 3, 4 and 6 should be performed this year and the remaining items within the next three to five years:

1. The gunite cover and wire mesh should be removed and replaced with a special concrete cover to protect the structural concrete from water erosion or spalling under frost. Until this is done the public should be prohibited from access to the downstream face because of the danger of slabs of gunite dislodging.

2. Deterioration of concrete on spillway piers, the outlet culvert and the gate control platform should be repaired. Reinforcing bars should be tested for degree of corrosion and existing cross section checked with design requirements prior to any concrete patching work.

3. Large debris that has collected below the downstream face and any debris caught on the crest should be removed now and periodically.

4. During the winter, the water level should be kept lower than the normal pool elevation to offset effects of ice thrust on the structure. The required amount of lowering should be determined by further analysis.

5. A specific plan for emergency operations and warning systems for the dam should be formulated and implemented.

6. The water level in the lake should be lowered to permit direct inspection of the upstream dam face and the outlet gate.

Respectfully submitted,

JOSEPH S. WARD AND ASSOCIATES

Edward A. Nowatzki

Edward A. Nowatzki, Ph.D., P.E.

Gary S. Salzman

Date: 21 July 1978

Gary S. Salzman, P.E.

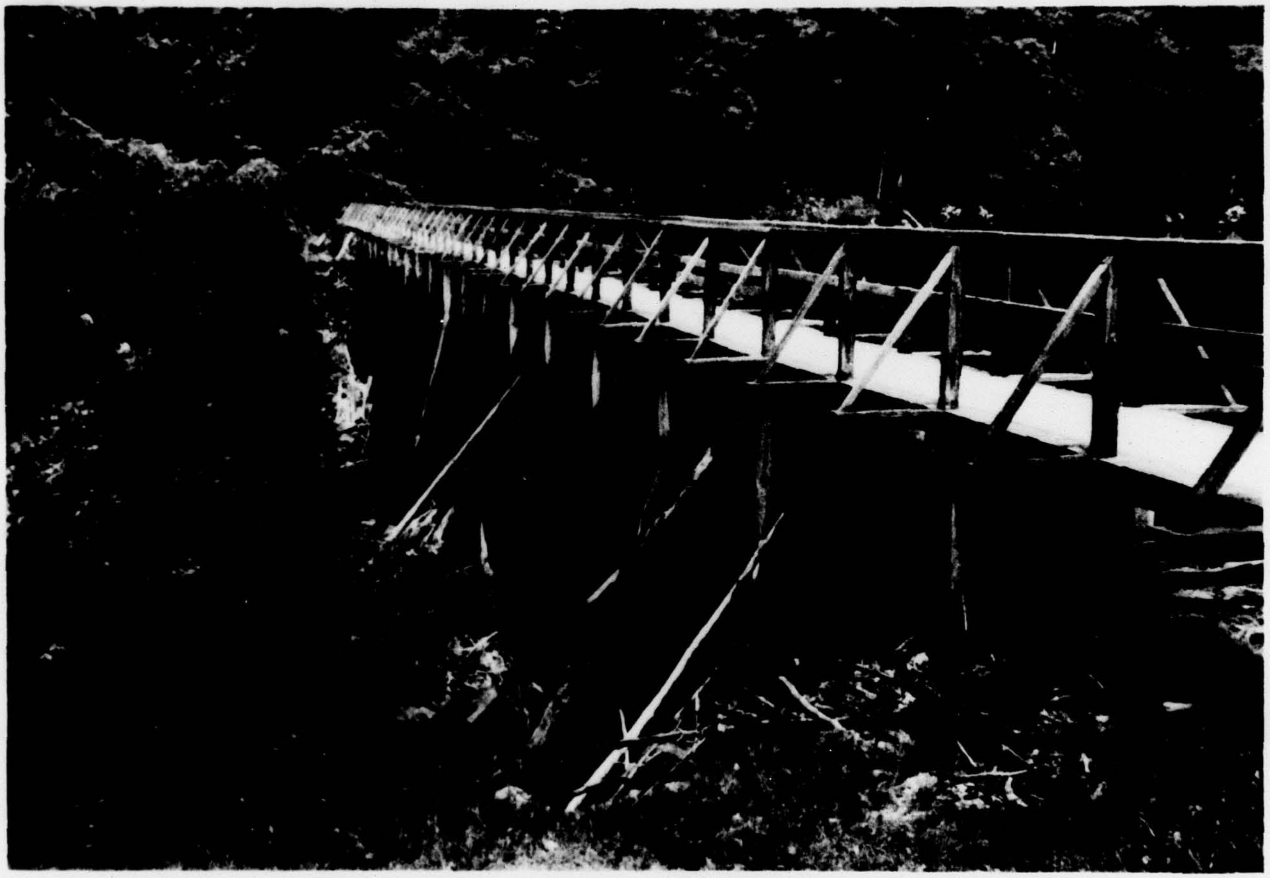
PROFESSIONAL ENGINEER
GARY S. SALZMAN
No. 40046
UNIVERSITY STATE OF NEW YORK

Approved by:

Clark H. Benn

Colonel Clark H. Benn
New York District Engineer

Date: 31 July 78



OVERVIEW - LAKE KANAWAUKE DAM

SECTION 1

PROJECT INFORMATION

1.1 General

a. Authority

The authority to conduct this Phase I inspection and evaluation comes from the National Dam Inspection Act (P.L. 92-367) of 1972 in which the Secretary of the Army was authorized to initiate, through the Corps of Engineers, a program of safety inspections of non-federal dams throughout the United States. Management and execution of the program within the State of New York has been undertaken by the New York State Department of Environmental Conservation (NYSDEC).

b. Purpose

The primary purpose of the inspection is to evaluate available data and to give an opinion as to whether the subject dam constitutes a hazard to human life or property.

1.2 Description of Project

a. Description of Dam and Appurtenances

The Lake Kanawauke Dam is a concrete gravity structure approximately 294 feet in length with a maximum height of approximately 20 feet. The dam consists of monolithic concrete sections of variable length, keyed to each other and to a pedestal footing approximately 16 feet wide and of variable thickness founded in rock. The entire front and rear faces, and top, of the monolithic concrete was gunited (reinforced with wire) in 1947. The spillway is 242 feet in length and begins about 35 feet from the right abutment. Nineteen sharp-pointed concrete piers, 1.5 feet wide and extending 2 feet above the spillway elevation, are located on 12-foot centers along the length of the spillway. A wooden footwalk extends over the piers along the length of the dam and provides access to controls for a low-level, 3'x3' sluiceway. The wheel mount (Rodney Hunt, Serial #55012A) for the sluice gate is located on a control tower at pier elevation approximately 169 feet from the right abutment. The invert of the sluiceway is approximately 18.75 feet below spillway elevation.

b. Location

The dam is located on Stony Brook in Rockland County, N.Y., approximately 6¼ miles northeast of Sloatsburg, N.Y. The location of the dam is shown on Plate I which is a composite taken from USGS 7.5 minute Quadrangle Sheets of Sloatsburg, N.Y.-N.J., N41°07'30", W74°07'30", and Thiells, N.Y., N41°07'30", W74°00'00". The nearest major river is the Ramapo River which flows through Sloatsburg, N.Y.

c. Size Classification

The dam is classified as "intermediate" (storage = 1400 acre-feet; height = 20 feet).

d. Hazard Classification

Because it is upstream from a popular summer resort (beach) area, and because there are permanent residences downstream from Lake Sebago, into which the flow from Lake Kanawauke empties, the hazard classification is "high".

e. Ownership

Palisades Interstate Park Commission
Bear Mountain, New York

f. Purpose of Dam

The dam was built to create an artificial lake for recreational and aesthetic purposes.

g. Design and Construction History

The dam was designed for the Commissioners of the Palisades Interstate Park by their chief engineer, W. A. Welch, in 1917. (Refer to Plate II.) An application for construction dated 3 September 1924 is on file with the NYSDEC. However, there is additional information in the file that indicates that the dam was under construction as early as October 1917. There is an internal memo of the NYS Conservation Commission dated 19 March 1918 quoting a complaint of the chief engineer of the Ramapo Mountains Water Power and Service Company, Inc., in which the adequacy of the design and construction procedures are questioned. There is also a report of an inspection of the dam made by the New York State Conservation Commission. This correspondence indicates that there was some question about the adequacy of the dam as it was being

constructed in October 1917. However, the description of the dam contained in the 9 April 1918 inspection report indicates that the as-built structure corresponds quite closely to the design drawings presented on Plate II. The correspondence referred to above is contained in Appendix E of this report.

The files of the Palisades Interstate Park Commission (PIPC) indicate that the dam was repaired in 1929 and again in 1934, but no information is available regarding the nature or extent of those repairs. (Refer to Plate III.)

The latest major modifications to the dam were made in accordance with a drawing dated 9 September 1947. (Refer to Plate IV.) No information regarding the actual construction of those modifications is available. From an inspection of the dam, it is apparent that they were indeed performed.

h. <u>Normal Operational Procedure</u>

The sluiceway gate is normally kept closed. It is opened only to supply water to a downstream impounding reservoir which is used to maintain the water elevation in Lake Sebago. According to personnel of the Palisades Interstate Park Commission, this is required about once or twice a year. The gate was partially opened by these personnel in our presence and it was observed to function satisfactorily. We were informed that the gate could be fully opened in 15 to 20 minutes.

1.3 <u>Pertinent Data</u>

a. <u>Drainage Area</u>

The drainage area is approximately 5 square miles.

b. <u>Discharge at Damsite</u>

Maximum known flood at damsite: 2400 cfs. (Estimated based on visual observations made by a PIPC employee with 43 years of service.)

Total spillway capacity at maximum pool elevation: 2400 cfs. (Spillway is ungated.)

c. <u>Elevation (ft. above MSL)</u>

Top of dam: 828.75.

Maximum pool (top of abutment seats): 829.75.

Normal pool (spillway crest): 827.75.

Upstream sluiceway invert: 809±.

Downstream sluiceway invert: 809±.

Streambed at sluiceway outlet: 808 (approximate).

d. Reservoir Length

Recreational (normal) pool: 1 mile (approximate).

Maximum pool: (unknown).

e. Storage (acre-feet)

Normal pool (spillway crest): 1558 (approximate).

Maximum pool (top of abutment seat): 1935 (approximate).

f. Reservoir Surface (acres)

Top of dam: 188.5 (approximate).

Maximum pool (top of abutment seat): 191.5 (approximate).

Recreation (normal) pool (spillway crest): 185.5 (approximate).

g. Dam

Type: Concrete gravity: monolithic sections keyed to each other and to variable thickness concrete foundation pedestal.

Length: 294 feet (including spillway).

Height: Variable near abutments; 20 feet from spillway crest to top of foundation pedestal along central portion.

Top width: 4'6" (nominal) along dam section; spillway is rounded crest.

Side slopes: 4 vertical to 1 horizontal on both upstream and downstream faces.

Cutoff: Concrete foundation of variable thickness rests on rock ledge. No keys, grout curtains, cutoffs, etc. indicated in drawings.

h. <u>Diversion and Regulating Tunnel</u>

Type: Low level, reinforced concrete sluiceway tunnel 3 feet wide, 3 feet high.

Length: 15 feet.

Closure: Manually operated, vertical gate, manufactured by Rodney Hunt Machine Co., Orange, Mass. Type 17503-2, Serial No. S-5012-A.

Access: To sluice gate - none.

To gate controls - via wooden platform that extends along entire length of dam and spillway.

Regulating facilities: Wheel mount for sluice gate is located on a tower 117 feet from right abutment and is accessible via wooden platform.

i. <u>Spillway</u>

Type: Masonry gravity; rounded crest.

Length of weir: 242 feet.

Crest elevation: 827.75.

Gates: None.

Piers: Supports for wooden walkway are located on 12-foot centers along entire length of spillway. The piers are sharp-pointed upstream and taper to a width of approximately 1.5 feet downstream. Their top is at elevation 829.75 (top of dam).

j. <u>Regulating Outlets</u>

Refer to Item h above.

SECTION 2

ENGINEERING DATA

2.1 Design

Very little engineering data were available for the subject dam and its appurtenant structures. The sources of the available data are:

a. "Application for the Construction of a Dam" filed by PIPC with the New York State Department of State Engineer and Surveyor. (Refer to Appendix E.) This document is dated 3 September 1924.

b. Two drawings:

i. A drawing dated 31 March 1917 by W. A. Welch, Chief Engineer of PIPC, which shows a plan and profile of the original structure and sections through the gate tower.

ii. A drawing dated 9 September 1947 by personnel of PIPC which shows the plans, elevations, sections and details for modifications to the dam. This drawing contains most of the detailed information on the geometry of the dam as it exists today. It is the second of two sheets; the other sheet could not be located.

Reduced reproductions of these drawings are presented as Plates II and IV, respectively. Information derived from these drawings was used to perform stability analyses.

c. A summary sheet of general data for all the lakes and dams in the Palisades Interstate Park prepared by PIPC. (Refer to Plate III.) Sources of data on this summary sheet could not be identified by PIPC, and some of the entries for the Lake Kanawauke Dam are obviously in error. For example, the batter of the downstream face is given on the summary sheet as 1 horizontal to 2 vertical whereas the 1947 drawing and visual observation show the correct batter to be 1 horizontal to 4 vertical. There are other slight discrepancies between the summary sheet data and data obtained from the drawings and construction application form. The reliability of the summary sheet data can, therefore, be questioned.

There is no information available on the nature or extent of the repairs indicated on the PIPC summary sheet to have taken place in 1921 and 1934.

There are no structural design or hydraulic/ hydrological computations available.

2.2 Construction

There are no formal construction records available for either the original construction or the modifications done in 1947. However, an inspection report of the NYS Conservation Commission dated 9 April 1919 contains a description of the project at an intermediate stage of its construction. (Refer to Appendix E.) This inspection resulted from a complaint filed by the chief engineer of the Ramapo Mountains Water Power and Services Company, Inc. in a report dated 19 February 1918 (not available at PIPC) and quoted in an internal memo of the NYS Conservation Commission dated 19 March 1918. (Refer to Appendix E.)

2.3 Operation

No formal records of operation or flow discharges are available. There is no recording instrumentation at the dam site. In speaking with the Senior Park Engineer, Mr. Robert Santoro, and his assistant engineer, Mr. Sevik, we were informed that controlled discharges from Lake Kanawauke were dependent upon water requirements of downstream Lake Sebago. The latter contains a large beach which provides recreational facilities for thousands of people during the summer months. The beach is immediately downstream (less than ½ mile) from the Lake Kanawauke Dam. In the past, controlled discharge has taken place as necessary, usually once or twice a year. However, there is no formal program for opening and testing the sluiceway control gates at regular intervals. Manual operation of the sluiceway gate was easily performed by one man. (Refer to Fig. 1, Appendix D.)

Although no formal records of flow discharge were available, information regarding maximum past flows was obtained by speaking with some of the long-time employees of PIPC. Mr. Frank Sansonetti, who was in charge of the gate control wheel and who has been a PIPC employee for 43 years, reported that the greatest flow he ever observed over the spillway occurred in the early 1970s (presumably at the time of Tropical Storm Agnes) when the water elevation rose up to within a few inches of the bottom of the wooden walkway. He did not recall ever having seen the walkway overtopped.

2.4 Evaluation

a. Availability

Engineering data were provided by the New York State Department of Environmental Conservation and by the owner, the Palisades Interstate Park Commission. The owner, via his senior engineer, made available an assistant engineer and valve crew for information and demonstrations of operational procedures during the visual inspection. The personnel interviewed by the inspection team were cooperative and very helpful.

b. Adequacy

The nature and amount of engineering data are limited, especially with regard to hydrology. Consequently, most of the engineering analyses proceed from assumptions based on an overall assessment of the available data, the results of the visual inspection, and the conversations with personnel of NYSDEC and PIPC.

c. Validity

The validity of the information contained on the PIPC summary sheet (Plate IV) may be questioned in view of the discrepancies between it and the 1947 drawing regarding batter (1:2 vs. 1:4), length of dam (300' vs. 294'), length of spillway (152' vs. 242').

SECTION 3

VISUAL INSPECTION

3.1 Findings

a. General

Lake Kanawauke is part of the "Seven Lakes" system located in the Bear Mountain State Park. Actually, only four of these lakes are in the same local drainage basin. Lake Askoti (Pool Elev. 911), Lake Skannatati (Pool Elev. 889) and Spring Pond (Pool Elev. unknown) all drain into Lake Kanawauke (Pool Elev. 828) and Little Long Pond (part of Lake Kanawauke), which themselves drain into the largest of the four lakes, Lake Sebago (Pool Elev. 771).

Lake Askoti is connected to Lake Skannatati via an ungated overflow spillway that empties into a culvert passing beneath Seven Lakes Drive. There is also a gated drainage structure, the controls to which are offshore and are accessible only by boat. According to PIPC personnel, Lake Askoti is lowered approximately every five years in order to control "pest" fish. Some debris was noted at the crest of the spillway.

There are three dams on Lake Skannatati. There is only one gated drainage structure, the controls to which are offshore. The major drainage into Lake Kanawauke from Lake Skannatati occurs over the westernmost dam, which has very little freeboard, and consists of a straight, shallow sloping, concrete spillway. Water in the approach channel appeared shallow, and a slight flow was taking place over the spillway on the day of the inspection. Local accumulations of large boulders and signs of severe bank erosion downstream from the spillway are indicative of heavy flows over this spillway.

The northern portion of Lake Kanawauke and Little Long Pond are connected to the southern portion of Lake Kanawauke via an ungated semi-circular, stone-faced culvert, approximately 15 feet in diameter (refer to Fig. 2, Appendix D) that runs beneath State Route 210. The invert of the culvert was about 1 foot below the water surface on the day of the inspection. The northern portion of Lake Kanawauke is joined to Little Long Pond via a similar culvert approximately ¼-mile farther west on State Route 210.

The dam on the southern portion of Lake Kanawauke is, therefore, a vital control section, and its

integrity is essential to the safety of those farther downstream, especially in view of the high density recreational use at Sebago Beach.

b. Dam

Since approximately 82 percent of the subject structure (242 feet out of a total of 294 feet) is spillway, the following observations apply to both the dam and the spillway. In general, both appear to be in generally good condition. It was difficult to notice whether seepage was occurring, since the vertical expansion joints between the original concrete monoliths had been covered with copper baffle strips when the dam was gunited in 1947. Besides, at the time of the first inspection, there was a slight flow over the spillway, which masked any seepage that might be occurring through the structure.

Subsequent inspection by Mr. Paul A. Gossen of Lev Zetlin and Associates on 7 July 1978 revealed that the dam's concrete did not show visible signs of structural distress. No observation of water leakage could be made at the pour and expansion joints because expansion joint covers set into the gunite prevented a thorough inspection of these areas. The gunite cover was badly deteriorated and to a large part delaminated from the concrete surface. Near the sluiceway as well as toward the west quarter mark of span, several square feet of gunite cover was missing and the wire mesh exposed. In addition, the base of all the spillway piers supporting the catwalk were badly deteriorated at the downstream side with the reinforcing exposed.

No inspection of the upstream face of the dam could be performed since the reservoir was full.

Although the dam appears to be functionally in good condition, a number of moderate deficiencies were noted. These include:

1) A number of spalls in the gunite cover of the downstream face (Fig. 3, Appendix D). These ranged from large to small, mostly in the center portion of the structure. The exposed wire fabric was badly rusted. In some instances the spalling had occurred at joints, and the copper baffle was clearly visible. The fact that there is evidence of patches indicates that this spalling has been a recurring problem for some time.

2) A number of large longitudinal cracks in the gunite near the center of the dam.

3) Evidence of severe to very severe scaling of the piers and control gate platform (Figs. 3 and 4, Appendix D). Close examination of one of the spalls in the gunite revealed that there was also some slight scaling of the original dam structure in that area.

c. Appurtenant Structures

The abutment walls, outlet works and sluice gate control access bridge all appeared to be in generally good condition and functioning satisfactorily. The following observations were made:

1) The abutments of the dam are part of the end concrete monoliths. The right abutment rests on a rock outcrop (Fig. 5, Appendix D) but it was not possible to determine if the abutment is anchored to the rock. There are no rock outcrops at the left abutment (Fig. 6, Appendix D). However, the existence of such outcrops nearby suggests that rock may be within several feet of the surface, and the design drawings indicate that the left abutment also rests on rock.

Inspection of the area immediately downstream of the abutments revealed that some erosion of the banks had taken place, probably many years ago. There is insufficient evidence to indicate whether the erosion occurred from water overtopping the dam section or from water coming around the abutments. In either case, there does not seem to be a danger of the dam washing out.

2) The sluice gate controls were operated (Fig. 1, Appendix D) and were observed to function satisfactorily. The gate itself could not be inspected since it was totally submerged. The outlet tunnel was inspected at its exit point and was found to be severely scaled and cracked (Fig. 3, Appendix D).

3) The wooden bridge that extends along the top of the dam appears to be in good condition (Fig. 7, Appendix D). Since this bridge provides access to the sluice gate controls, it is essential that it be well maintained.

4) A water supply pipeline extends across the dam just below the wooden walkway (Fig. 6, Appendix D). The pipeline appears to be in good condition, with no evidence of leakage observed.

5) Flashboard pins (Fig. 3, Appendix D) along the length of the spillway are quite rusted. They seem to have not been used for some time. Under normal spillway

operation, they are spaced closely enough to trap debris on the spillway crest.

d. Foundation

The foundation of this structure was not visible.

e. Reservoir Area

Although the owner's records indicate that no sedimentation survey has ever been performed, there is no indication that sedimentation is a problem with this reservoir. The flow coming out of the outlet tunnel when the sluice gate was open did not appear to contain sediment at the time of our inspection (Fig. 8, Appendix D). The slopes in the reservoir area are heavily wooded and have considerable ground vegetation. Therefore, the materials that collect on the bottom are mostly organic and decay in time. The slopes on the right shore are inclined at approximately 2 horizontal to 1 vertical and the slopes on the left shore are inclined at about 4 horizontal to 1 vertical (Fig. 9, Appendix D). There was no evidence of sloughing or sliding observed around the reservoir, based on our field visit and examination of stereo-pairs of air photos. The land surrounding the reservoir is owned by a bi-state government agency. Its development is controlled and now contains only a few recreational camps. This type of land usage is not expected to change.

f. Downstream Channel

The downstream channel is about 30 to 40 feet wide with side slopes approximately the same as along the reservoir (Fig. 10, Appendix D). Numerous large boulders were observed in the channel out to about 30 feet from the toe of the dam. There is also a considerable amount of debris at the toe (Fig. 11, Appendix D). These serve as an apron and energy dissipator. A few large trees are in the channel and on the slopes farther downstream. The channel slopes appear generally stable, although some minor local slide scars were noted in the vicinity in air photos. About 500 feet downstream there is a large, boulder-covered detention basin (Fig. 12, Appendix D). This basin is used to store water and act as a flood control pond for Sebago Beach (Fig. 13, Appendix D) that lies downstream immediately beyond a two-lane paved road.

3.2 Evaluation

The subject dam and its appurtenant structures seem to be in generally good condition and are expected to continue to function satisfactorily under normal conditions. There was nothing observed at the time of the inspection to indicate that the structure is unsafe. The deterioration of the gunite that was observed is not expected to be detrimental to the operation of the dam, although water trapped at the delaminated surfaces will cause spalling of the original concrete dam under frost. In addition, it is possible that slabs of gunite may dislodge in the future. This situation creates a safety hazard to the public and in particular to occupants of nearby camps. The external appearance of the dam could be made aesthetically more pleasing if a program of periodic maintenance were established and followed.

SECTION 4

OPERATIONAL PROCEDURES

4.1 Procedures

Mr. Robert Santoro, Senior Park Engineer, and Mr. Paul Sevik, Park Engineer, indicated that there are no formal procedures for operating the dam. Ordinarily, the level in the Lake Kanawauke Dam is maintained naturally at or close to the spillway crest. Occasionally, the level is dropped significantly for maintenance purposes. For example, last year it was down about 14 feet for a day or two. There does not seem to be any system-wide operational procedure by which inflow and outflow among the four lakes in the local drainage area can be controlled.

4.2 Maintenance of Dam

The dam receives less maintenance than required to make the structure aesthetically pleasing; however, its integrity does not seem to have been compromised to date by this lack of maintenance.

4.3 Maintenance of Operating Facilities

The controls to the sluice gate appear to be maintained satisfactorily, although the submerged portion of the gate control rod seemed to be rusty.

4.4 Warning Systems in Effect

There are no formal warning systems in effect for the dam itself. There is, however, a general administrative directive of PIPC that covers all emergencies in Bear Mountain Park. Mr. Santoro advised us that this directive (refer to Appendix E) would be followed in the case of an impending failure of the dam. According to this directive, personnel of the engineering department could be reached by telephone at any time of the day or night to evaluate a potentially dangerous situation. Evacuation of downstream areas could then be ordered, if necessary. The PIPC Police would implement such an evacuation order by themselves and by downstream authorities with whom they maintain radio contact.

4.5 Evaluation

The dam and its appurtenant structures do not seem to be subject to a formal, periodic maintenance program. This lack of periodic maintenance apparently has not yet

compromised the integrity of the dam. The emergency alert system in effect appears to be satisfactory, although there is no specific warning system with respect to the dam itself. It was noted that there is no system-wide procedure for controlling flows among the four lakes in the local drainage area; a carefully formulated procedure could minimize the extent of flooding in the lake system.

SECTION 5

HYDRAULICS AND HYDROLOGY

5.1 Evaluation of Hydraulic Features

a. Design Data

The spillway as originally designed and built was sharp-crested with a nominal width of 4 feet as shown in Plate II. In 1947, the downstream edge of the crest was rounded and the upstream edge inclined as shown in Plate IV. The effects of these modifications on the hydraulic performance of the structure were not evaluated in 1947, as best we can determine.

Structural details of the sluice gate and passageway are also found on Plates II and IV; however, there are no data or computations available on their hydraulic performance. Flow computations performed as part of this study are found in Appendix C.

b. Experience Data

No formal data or measurements are available.

c. Visual Observations

The spillway and sluice appeared to be functioning satisfactorily on the day of the inspection. Debris caught on the flashboard pegs could possibly impair the design performance of the spillway.

5.2 Evaluation of Hydrologic Features

a. Design Data

No hydrologic data or analyses could be found in the records for the Lake Kanawauke Dam and watershed. There are no gaging stations in the local basin. According to the Recommended Guidelines for Safety Inspection of Dams, Department of the Army, OCE, the recommended spillway design flood (SDF) for the subject dam is the probable maximum flood (PMF) since the dam is of intermediate size and poses a high hazard.

b. Experience Data

Information on the PMF for the Lake Kanawauke Dam and watershed was obtained from the Hydrologic Flood Routing Model for Lower Hudson River Basin prepared for

the New York District of the U.S. Army Corps of Engineers (USACE) by Water Resources Engineers, Inc., Springfield, Virginia. In this study, the rainfall-runoff mathematical model HEC-1 was used to reconstitute the major historical floods and to simulate the standard project flood (SPF). In addition to the SPF simulation, the rainfall pattern for Tropical Storm Agnes was transposed and centered over Poughkeepsie, N.Y. and the discharges resulting from this rainfall were determined by an application of the calibrated model. In a telephone conversation with Mr. Thomas Smyth, USACE New York District, we were informed that for Phase I hydrologic analyses, the SPF could be considered as one-half of the PMF.

The Lake Kanawauke Dam and drainage basin were located within Subarea 2 of the Ramapo River Basin as defined in the USACE study. Computations for routing both the SPF and PMF through the Lake Kanawauke Dam are found in Appendix C of this report.

c. Visual Observations

Interviews with long-time PIPC employees revealed that the maximum observed flood in their recollection (43 years ±) occurred when the water rose over the spillway to within a few inches of the bottom of the support beams of the wooden walkway. This would correspond to approximately 1½ to 2 feet over the spillway crest. In the recollection of the PIPC personnel, this flood occurred in the early 1970s (possibly at the time of Tropical Storm Agnes). Flows computed on the basis of these observations (2400 cfs for a water level 2 feet above the spillway crest and 1450 cfs for a water level 1½ feet above the spillway crest) correspond quite well with what the model studies indicate would have been the SPF (2450 cfs) and transposed Tropical Storm Agnes Flood (1270 cfs) for the Lake Kanawauke drainage area (refer to Appendix C).

d. Overtopping Potential

The subject dam is considered to be overtopped when the flow of water over the spillway and dam sections of the structure occurs at an elevation greater than that of the abutment (El. 830.75), i.e. depth of flow greater than 3 feet above spillway crest. The computations (refer to Appendix C) show that, in the light of this definition of overtopping, the dam

i. has probably never been overtopped.

ii. would just be able to pass the SPF (one-half of the PMF) without obstruction from the wooden walkway. Water surface elevation is approximately 829.75 at the SDF. Bottom of wooden walkway is at elevation 829.75.

iii. would probably not be able to pass the SDF (in this case the PMF) without obstruction by the wooden walkway and breaching around the abutments. Water surface elevation is approximately 830.45 at the SDF, and although the top of the abutments is at elevation 830.75, the shoreline adjacent to the abutments is lower (see Fig. 5, Appendix D).

e. Spillway Adequacy

Although the spillway capacity, in light of the definition of overtopping given above, is inadequate with respect to passing the recommended SDF, it can pass approximately one-half of the PMF without trouble. The spillway is therefore not seriously inadequate, as defined in DAEN-CWE-HY Engineer Technical Letter No. 1110-2-234. Furthermore, even if it were to be overtopped by the PMF, computations in Appendix F show that, for the height of water estimated at PMF conditions, the dam would still be stable. The abutments, although breached at the PMF, would probably not be washed out since they appear to be founded on bedrock, based on the drawings and our visual observations.

f. Hazard Potential

The quantity of water passing over the Lake Kanawauke Dam during a PMF would be sufficient to create heavy and potentially dangerous flows immediately downstream and through the Sebago Beach area; such a flood might imperil the dam on Lake Sebago, and hence the residences observed downstream from Lake Sebago. The "high" hazard potential designated for the Lake Kanawauke Dam is therefore considered appropriate.

SECTION 6

STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observations

Visual observation of the concrete gravity structure did not disclose any sign of structural instability. The alignments, both horizontal and vertical, appear to have been maintained since completion of the dam and its later modifications.

b. Design and Construction Data

No stability computations for the original structure of 1917 or the modified structure of 1947 were available for review. However, the 1947 drawings provided information for stability analyses (overturning, sliding, foundation crushing) for the dam under the following conditions:

i) Headwater elevation at 829.75 (abutment seat elevation). This represents conditions slightly more severe than the worst overflow condition observed by PIPC personnel in the past.

ii) Headwater elevation at 830.45 (the PMF level).

iii) Ice, 18 inches thick, covering the lake at spillway elevation. This ice thickness is representative of winter conditions in the area.

In all analyses, full uplift pressures were assumed since there are no data to indicate the existence of drains. The computations for stability are presented in Appendix F. The results of the analyses indicate:

i) Under the 2 and 2.7 feet overflow condition, the factors of safety are adequate for the conservative assumptions made. The computed factors of safety are:

For overflow of 2 feet

- Overturning: >1.3
- Sliding: >1.1
- Compression: >10.0

For overflow of 2.7 feet

- Overturning: >1.3
- Sliding: >1.0
- Compression: >10.0

ii) Under the ice load condition, the factors of safety are marginal, at best, for the conservative assumptions made. This would tend to indicate that the water level should be lowered during the winter months. The computed factors of safety are:

For 18" ice thickness at crest of spillway

- Overturning: 1.0±
- Sliding: >1.0
- Compression: 2.0

c. Operating Records

There are no formal operating records from which to evaluate the stability of the subject structure. Accounts of observers who witnessed what was probably equivalent to the SPF (Standard Project Flood) suggest that the dam passed this flood without damage to itself or loss of its structural stability.

d. Post Construction Changes

The post construction changes performed in 1947 do not seem to have affected the stability of the original structure. If anything, these changes improved the stability. The gunite shell added more weight to the structure. Rounding of the spillway crest lessened the chance of flow separation.

e. Seismic Stability

Lake Kanawauke dam is nominally located in Seismic Zone 1 according to the Algermissen Seismic Risk Map. Although earthquakes that cause minor damage can be expected to occur in this zone, they are not likely to have a major effect on low fundamental period structures such as small, concrete gravity dams. Ordinarily a dam of such a type that is stable under static conditions is also considered to be stable under earthquake conditions in Zone 1. However, no computations were performed to verify this assessment for the subject dam. It is

interesting to note that approximately one week after the date of the inspection, a magnitude 3.0 event occurred along the Ramapo Fault which is within 5 miles of the subject dam. No damage to the dam was reported to us.

SECTION 7

ASSESSMENT, RECOMMENDATIONS AND REMEDIAL MEASURES

7.1 Dam Assessment

a. Safety

Visual inspection of the system and a review of the limited available engineering data indicate that the dam is in generally good condition and functioning satisfactorily at this time. There is no evidence to indicate the existence of presently unsafe conditions. However, rough calculations based on the available data and conservative assumptions indicate that the factors of safety with regard to stability are not as high as those recommended by the Corps of Engineers guidelines. If the recommended replacement of the gunite cover is not done, deterioration of the concrete core section will occur and the safety of the dam may be compromised.

Our approximate hydrologic/hydraulic calculations indicate the spillway cannot contain the PMF without the dam being overtopped. Overtopping is defined here as flow over the abutment sections of the dam, 3.0 feet above the spillway crest. Therefore, based on OCE screening guidelines, the spillway capacity is inadequate. In that our calculations indicate that the spillway can contain a flow of about ½ PMF, the spillway would not be classified as seriously inadequate.

b. Adequacy of Information

The information available to us is not adequate for a detailed analysis of the structure or its operation under other than normal conditions. The information is sufficient, in conjunction with the results of the visual inspection, to make a reasonable assessment of the system's present condition.

c. Urgency

The remedial work recommended below is not critical in terms of urgency. It should be done as soon as practicable; some items can readily be accomplished this year, but all should definitely be within the next three to five years. However, until such work is done, the public should be prohibited from access to the downstream face in order to prevent injury from spalling concrete or falls from amassed debris.

d. Necessity for Further Inspections

1) The water level of the lake should be dropped to outlet culvert level and arrangements made with the NYSDEC to inspect the upstream face, and to observe the condition of the gate and gate stem.

2) At the time the gunite cover is removed, as recommended below, another inspection should be made to evaluate the water tightness of the expansion joints now covered by copper baffles.

7.2 Recommendations and Remedial Measures

a. Alterations/Repairs

1) Gunite on downstream face and upstream face (if indicated by inspection recommended above) should be stripped completely and replaced. Consideration should be given to retroweling the surface with a special concrete cover to protect the structural concrete from water erosion. The existing cross section should be checked against design dimensions before any concrete repair work is undertaken.

2) All other concrete appurtenances such as the walkway piers, gate control platform and outlet culvert should be repaired. Reinforcing rods should be tested for degree of corrosion prior to any concrete patching work.

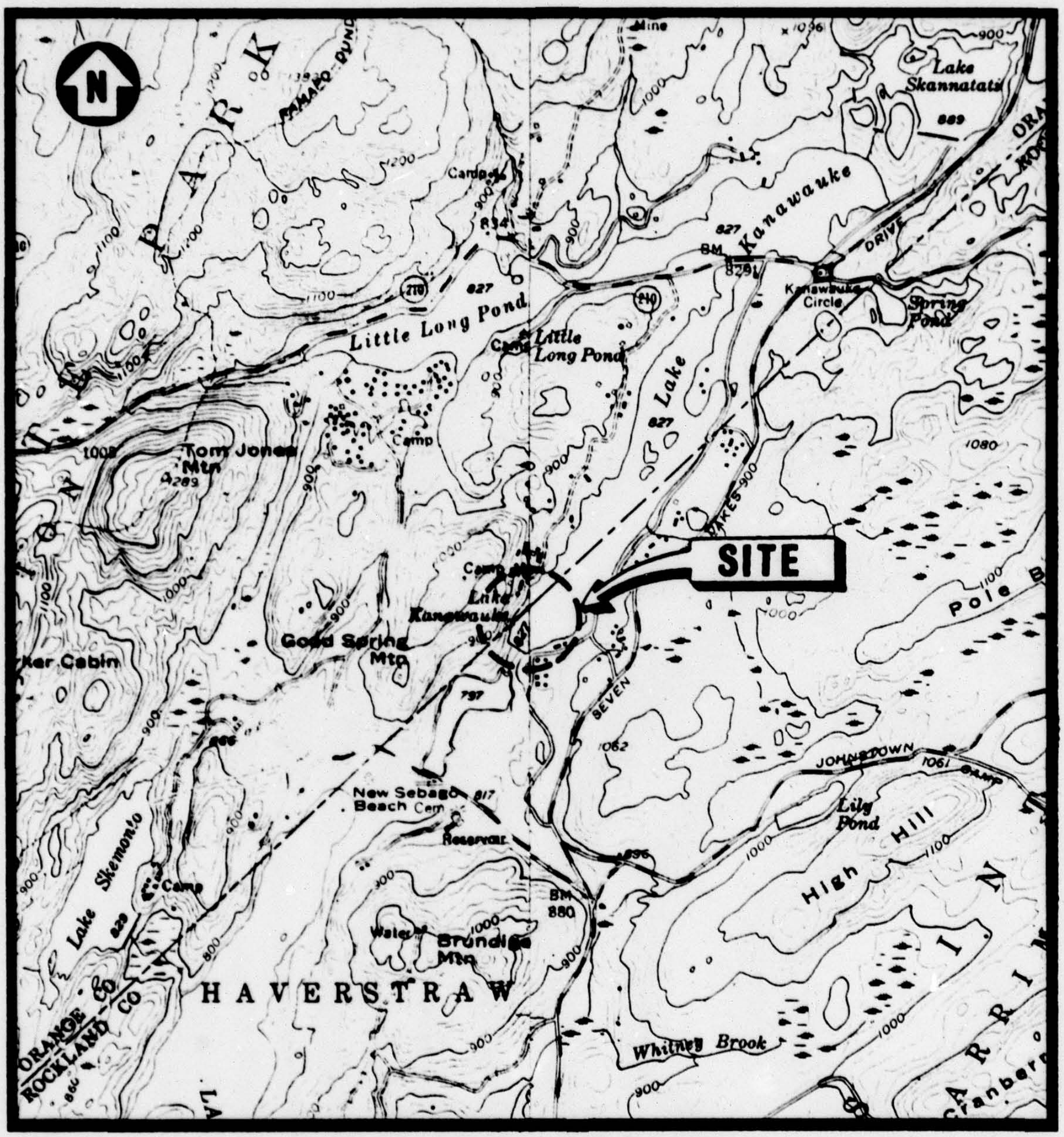
b. Operations and Maintenance Procedures

1) A program of periodic maintenance of the dam should be established and followed.

2) During the winter the water level should be kept below the spillway level to offset the overturning effects of ice thrust on the structure. The amount of lowering required should be determined by further analysis.

3) Steps should be taken to formulate and implement a specific emergency operation and warning system for the dam; the plan should be written into the PIPC Administrative Manual. Part of the procedure could include monitoring flows during periods of heavy precipitation, and frequent checks on the apparent physical condition of the dam, its abutments and foundations during periods of heavy flow.

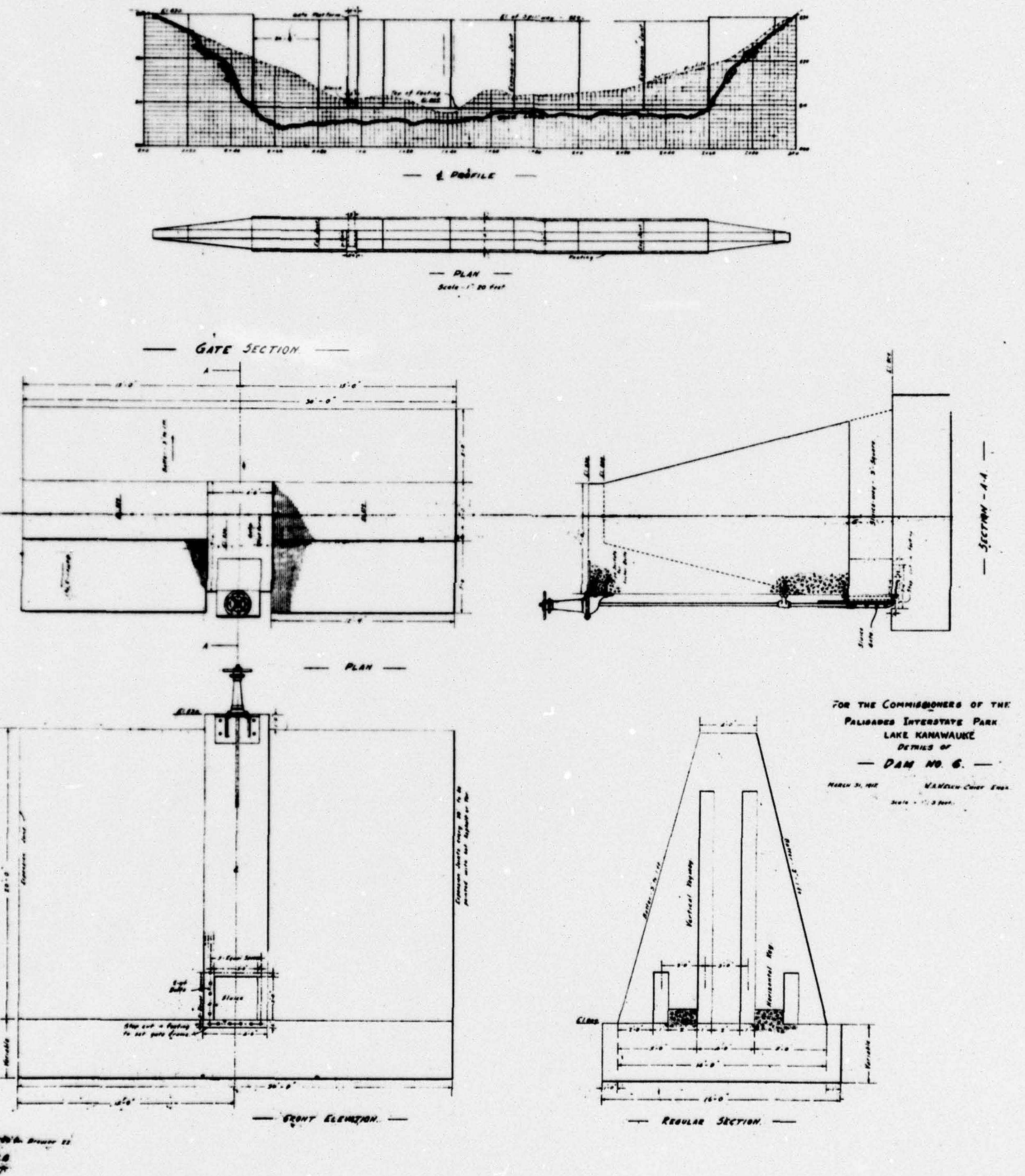
4) Large pieces of debris immediately downstream and any debris collecting on the spillway should be removed, and the area kept clear of such debris in the future.



SCALE 1"=2000'

MAP SOURCE: BASE MAP WAS ADAPTED FROM U.S. GEOLOGICAL SURVEY MAPS, SLOATSBURG, N.Y.-N.J. AND THIELLS, N.Y. QUADRANGLE, 7.5 MINUTE SERIES. 1955. (BASE MAPS MAY NOT REFLECT RECENT CARTOGRAPHIC CHANGES).

PLATE I SITE LOCATION MAP



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PHASE I - NATIONAL DAM SAFETY PROGRAM
LAKE KANAWAUKE DAM

PLATE II JULY 1978

GENERAL DATA — LAKES & DAMS IN THE PALISADES INTERSTATE PARK

NAMES OF LAKES	NATURE OF LAKE	ELEVATION	RATIO OF DRAINAGE AREA TO AREA OF LAKE	SIZE OF LAKE, ACRE	DRAIN AREA,
BARNES	ARTIFICIAL	894	37:1	14.7	55
WELCH LAKE BEAVER POND	"	1015	8:1	216	180
BREAKNECK	"	1083	5:1	66	32
BROOKS	"	139	4½:1	25.5	11
COHASSET UPPER	"	901	24:1	40	96
" LOWER	"	863	81:1	13	105
HESSIAN	NATURAL-ENLARGED	156	6½:1	32.8	21
ISLAND POND	"	961	19:1	51.4	98
KANAWAUKE	ARTIFICIAL	827.75	16:1	185.5	3040
NAWAHUNTA	"	781	87:1	15.2	1330
PINE MEADOW #1	"	972	8:1	77.5	580
OONOTOOKWA PINE MEADOW NO. 2	"	980	40:1	17.6	705
QUEENSBORO	"	453	162:1	35	5684
SEBAGO	"	772	19:1	310.6	5825
SPRING POND	"	872	106:1	2.7	285
STAHAHE	NATURAL-ENLARGED	715	10:1	88.2	871
SUMMIT	ARTIFICIAL	1065.1	6:1	33.7	211
SWIMMING POOL	"	99	476:1	0.5	238
TE-ATA	"	859	31:1	31	978
TIORATI	NATURAL-2 LAKES ENLARGED	1032	3:1	291	943
TURKEY HILL	ARTIFICIAL	610	8:1	58.4	472
TWIN UPPER	NATURAL	895.6	21:1	21.6	457
" LOWER	"	~~861~~	38:1	22.7	866
SILVER MINE LAKE BOCKEY SWAMP, MENOMINI	ARTIFICIAL	715	29:1	83.9	2437

3040	SPRING POND	0.033	0.233	1735 C.F.S.	GRAVITY	21'
1330		0.022	0.248	948 C.F.S.	COREWALL	10'
580		0.050	0.100	405 C.F.S.	GRAVITY & COREWALL	7' 20'
705		0.022	0.140	511 C.F.S.	GRAVITY & COREWALL	14' 13'
5684	NAWAHUNTA LAKE	0.024	0.238	2790 C.F.S.	GRAVITY	19'
5825	KANAWAUKE.	0.021	0.193	2696 C.F.S.	GRAVITY & COREWALL	29' 30'
285		0.046	0.219	290 C.F.S.	EARTHFILL BETWEEN 2 WALLS	17
871		0.050	0.250	692 C.F.S.	GRAVITY	13.5
211			0.190	223 C.F.S.	EARTH DRY WALL	AVERAGE 7.5
238	HESSIAN	0.033	0.330	280 C.F.S.	GRAVITY	15.6
978	UPPER & LOWER TWIN L	0.022	0.152	666 C.F.S.	GRAVITY & COREWALL	23 60
943	SPRINGS		0.200	694 C.F.S.	GRAVITY	22
472		0.022	0.330	468 C.F.S.	COREWALL	25
457		0.030	0.145	372 C.F.S.		
866	UPPER TWIN LAKE	0.024	0.167	623 C.F.S.		
2437	LAKE NAWAHUNTA	0.048	0.220	1450 C.F.S.	COREWALL	33.5'

152'				1917	1929 1934	6	507,641,250	5.73 Mi.	
36				1915		4	22,243,000	0.65 Mi	
58'-10"				1934		13	288,980,000	2.25 Mi.	
82				1934 INCOMPLETE		21	56,100,000		NOT
114	2.0			1915	1936	5	56,000,000	1.45 Mi	
160				1925	1935	10	1,262,586,600	6.48 Mi.	
10					1934		4,998,500	0.27 Mi.	
58	1.0			1918	1931 1943	7	229,383,475	3.15 Mi.	
5.5	1.35			1873	1933		109,804,300	1.34 Mi.	
4				1924			2,250,000		
35.5				1927		11	77,000,000	1.20 Mi.	
20				1915	1924 1930	2	1,661,726,880	4.83 Mi.	
30				1934		14	151,468,000	1.90 Mi.	
							105,568,500	0.83 Mi.	
							88,755,765	1.08 Mi.	
85'				1934	1937	20	465,000,000	1.70 Mi.	

OF 3 NE	
i.	
Mi.	
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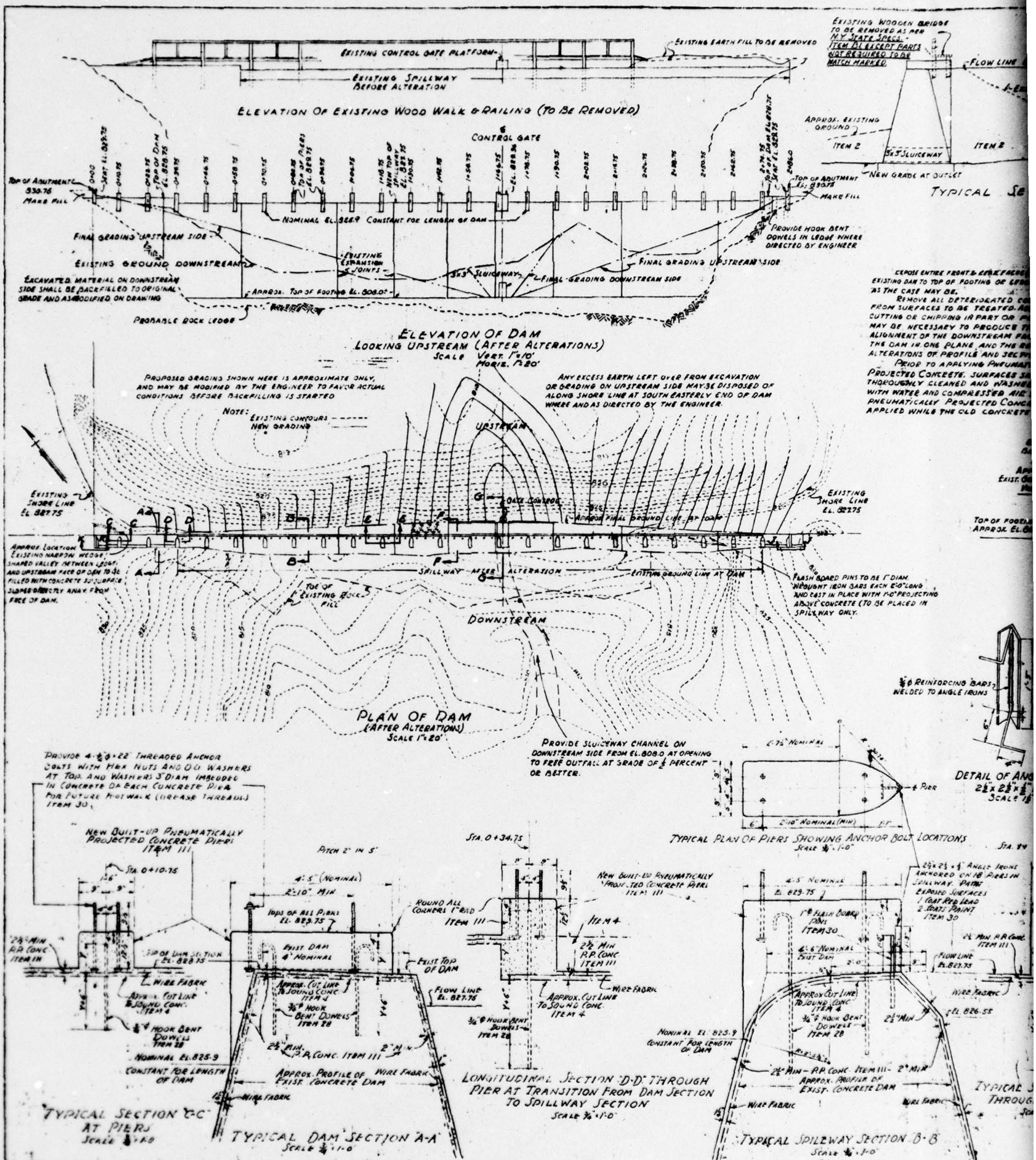
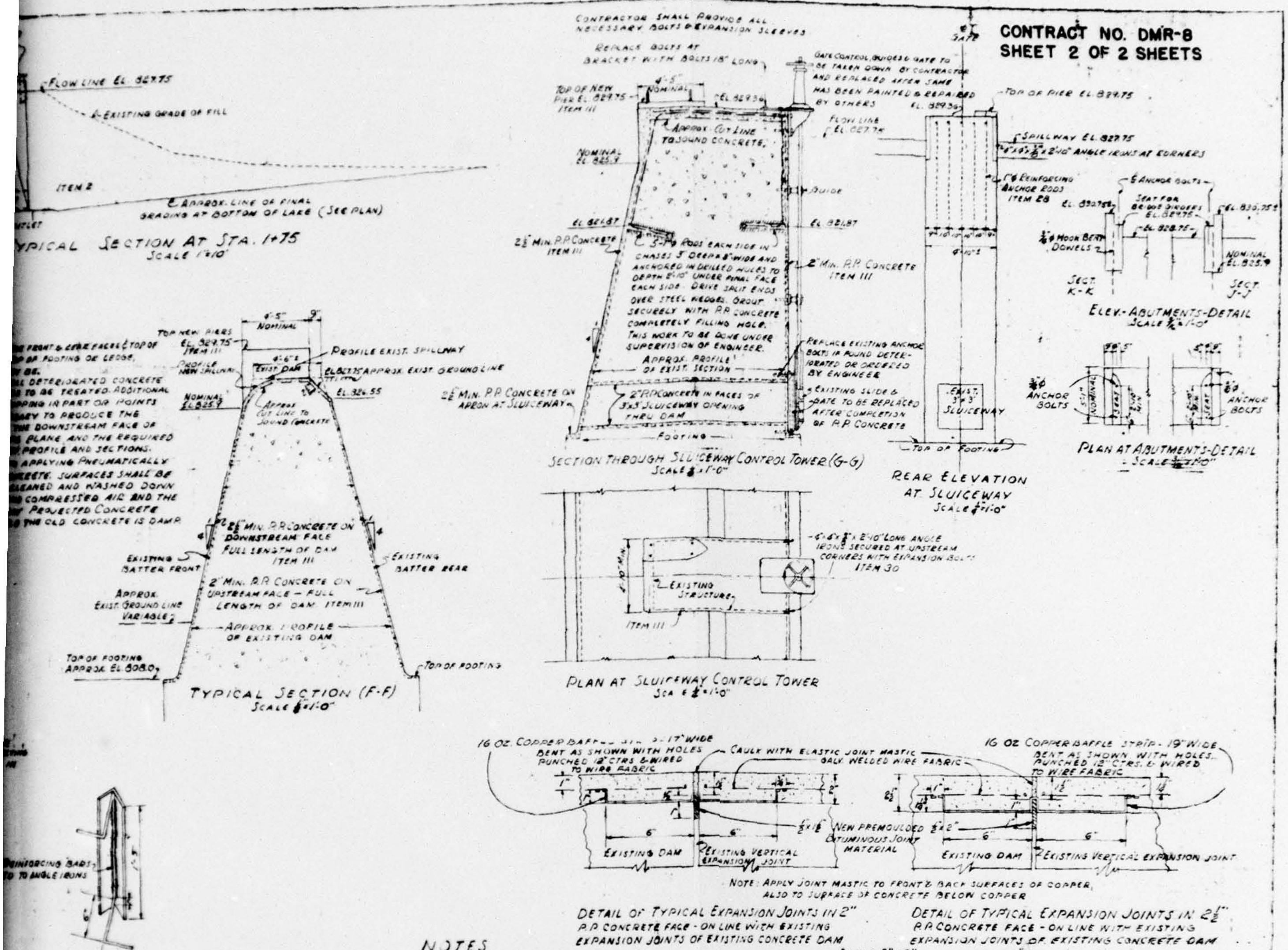
LAKE KANAWAUKE DAM

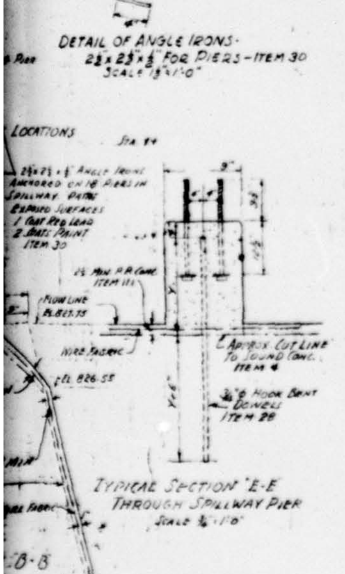
PLATE III JULY 1978



EXISTING CONTROL GATE PLATFORM
EXISTING EARTH FILL TO BE REMOVED
EXISTING SPILLWAY BEFORE ALTERATION
ELEVATION OF EXISTING WOOD WALK & RAILING (TO BE REMOVED)
EXISTING WOODEN BRIDGE TO BE REMOVED AS PER N.Y. STATE SPECS. ITEM 61 EXCEPT PARTS NOT REQUIRED TO BE MATCH MARKED.
FLOW LINE
APPROX. EXISTING GROUND
ITEM 2
5x5 SLUICEWAY
NEW GRADE AT OUTLET
TYPICAL SE
CONTROL GATE
Top of Abutment 830.75 Make Fill
NOMINAL EL. 825.9 CONSTANT FOR LENGTH OF DAM
FINAL GRADING UPSTREAM SIDE
EXISTING GROUND DOWNSTREAM
EXISTING EXPANSION JOINTS
5x5 SLUICEWAY
FINAL GRADING DOWNSTREAM SIDE
FINAL GRADING UPSTREAM SIDE
PROVIDE HOOK BENT DOWELS IN LEDGE WHERE DIRECTED BY ENGINEER
EXCAVATED MATERIAL ON DOWNSTREAM SIDE SHALL BE BACKFILLED TO ORIGINAL GRADE AND AS MODIFIED ON DRAWING
APPROX. TOP OF FOOTING EL. 808.0
PROBABLE ROCK LEDGE
ELEVATION OF DAM LOOKING UPSTREAM (AFTER ALTERATIONS) SCALE VERT. 1"=10' HORIZ. 1"=20'
PROPOSED GRADING SHOWN HERE IS APPROXIMATE ONLY, AND MAY BE MODIFIED BY THE ENGINEER TO FAVOR ACTUAL CONDITIONS BEFORE BACKFILLING IS STARTED
NOTE: EXISTING CONTOURS ----- NEW GRADING
ANY EXCESS EARTH LEFT OVER FROM EXCAVATION OR GRADING ON UPSTREAM SIDE MAY BE DISPOSED OF ALONG SHORE LINE AT SOUTH EASTERLY END OF DAM WHERE AND AS DIRECTED BY THE ENGINEER.
UPSTREAM
EXISTING SHORE LINE EL. 827.75
GATE CONTROL
APPROX. FINAL GROUND LINE AT TOP
APPROX. LOCATION EXISTING NARROW WEDGE SHAPED VALLEY BETWEEN LEDGES AND UPSTREAM FACE OF DAM TO BE FILLED WITH CONCRETE SO SURFACE SLOPES DIRECTLY AWAY FROM FACE OF DAM.
SPILLWAY AFTER ALTERATION
EXISTING GROUND LINE AT DAM
TOE OF EXISTING ROCK FILL
FLASH BOARD PINS TO BE 1" DIAM. WROUGHT IRON BARS EACH 2'-0" LONG AND CAST IN PLACE WITH 1'-0" PROJECTING ABOVE CONCRETE (TO BE PLACED IN SPILLWAY ONLY.
DOWNSTREAM
EXPOSE ENTIRE FRONT & CREST FACES OF EXISTING DAM TO TOP OF FOOTING OR LEDGE AS THE CASE MAY BE.
REMOVE ALL DETERIORATED CONCRETE FROM SURFACES TO BE TREATED. CUTTING OR CHIPPING IN PART OR ... MAY BE NECESSARY TO PRODUCE ... ALIGNMENT OF THE DOWNSTREAM FACE ... THE DAM IN ONE PLANE AND THE ... ALTERATIONS OF PROFILE AND SECTION
PRIOR TO APPLYING PNEUMATICALLY PROJECTED CONCRETE, SURFACES SHALL BE THOROUGHLY CLEANED AND WASHED WITH WATER AND COMPRESSED AIR ... PNEUMATICALLY PROJECTED CONCRETE APPLIED WHILE THE OLD CONCRETE ...
PLAN OF DAM (AFTER ALTERATIONS) SCALE 1"=20'
PROVIDE SLUICEWAY CHANNEL ON DOWNSTREAM SIDE FROM EL. 808.0 AT OPENING TO FREE OUTFALL AT GRADE OF ½ PERCENT OR BETTER.
¾" Ø REINFORCING BARS WELDED TO ANGLE IRONS
DETAIL OF ANG 2½ x 2½ x ¼ SCALE
PROVIDE 4-⅞"Ø×22" THREADED ANCHOR BOLTS WITH HEX NUTS AND O.G. WASHERS AT TOP AND WASHERS 3" DIAM IMBEDDED IN CONCRETE OF EACH CONCRETE PIER FOR FUTURE FOOTWALK (GREASE THREADS) ITEM 30.
NEW BUILT-UP PNEUMATICALLY PROJECTED CONCRETE PIERS ITEM 111
TYPICAL PLAN OF PIERS SHOWING ANCHOR BOLT LOCATIONS SCALE ¾"=1'-0"
PITCH 2" IN 5'
STA. 0+34.75
TOPS OF ALL PIERS EL. 829.75
ROUND ALL CORNERS 1" RAD ITEM 111
EXIST DAM 4" NOMINAL
EXIST TOP OF DAM
FLOW LINE EL. 827.75
APPROX. CUT LINE TO SOUND CONC. ITEM 4
¾" Ø HOOK BENT DOWELS ITEM 28
2½" MIN. P.P. CONC. ITEM 111 2" MIN.
APPROX. PROFILE OF EXIST. CONCRETE DAM
WIRE FABRIC
NOMINAL EL. 825.9 CONSTANT FOR LENGTH OF DAM
TYPICAL SECTION "C-C" AT PIERS
TYPICAL DAM SECTION "A-A" SCALE ¾"=1'-0"
LONGITUDINAL SECTION "D-D" THROUGH PIER AT TRANSITION FROM DAM SECTION TO SPILLWAY SECTION SCALE ¾"=1'-0"
1" Ø FLASH BOARD PINS ITEM 30
2'-6" NOMINAL
2½ x 2½ x ¼ ANGLE IRONS ANCHORED ON 18 PIERS IN SPILLWAY. PAINT EXPOSED SURFACES 1 COAT RED LEAD 2 COATS PAINT ITEM 30
EL. 826.55
TYPICAL SPILLWAY SECTION "B-B" SCALE ¾"=1'-0"

2





NOTES

NEW YORK STATE SPECS. ITEM NUMBERS, SHOWN IN TABLE, REFER TO THE SPECIFICATIONS ADOPTED JAN 2, 1947 BY THE NEW YORK STATE DEPT. OF PUBLIC WORKS, DIV. OF CONSTRUCTION. ALL WORK AND MATERIALS TO BE IN ACCORDANCE WITH SAID SPECIFICATIONS AND AS SHOWN OR DIRECTED BY THE ENGINEER.

VERIFY ALL DIMENSIONS AT THE DAM.

ALL HOOK BENT ANCHOR DOWELS & PINS, PRIOR TO PLACING OF NEW CONCRETE, SHALL BE FIRMLY GROUTED IN PLACE (USING A 1:1 PORTLAND CEMENT MORTAR) IN HOLES 2" IN DIAMETER DRILLED IN SOUND CONCRETE, OR LEDGE AS THE CASE MAY BE, TO DEPTHS SHOWN OR OTHERWISE ORDERED.

ALL COPPER BAFFLES, AT EXISTING VERTICAL EXPANSION JOINTS, TO BE LAID CONTINUOUS FROM TOP OF FOOTING, OR LEDGE, ON DOWNSTREAM SIDE OVER TOP OF DAM TO TOP OF FOOTING, OR LEDGE, ON UPSTREAM SIDE.

DIMENSIONS NOTED AS NOMINAL OR MIN. MAY BE CHANGED BY THE ENGINEER TO MEET ACTUAL CONDITIONS IN THE FIELD, BUT MUST BE MAINTAINED THE SAME THROUGHOUT DAM UNLESS OTHERWISE PERMITTED.

IN ALL DRILLING IN EXISTING CONCRETE STRUCTURE USE STAR-POINT DRILLS WITH AIR BLOW THROUGH CENTER OF DRILL TO AVOID SHATTERING LARGE STONES WHICH MAY BE ENCOUNTERED IN OLD CONCRETE.

ITEMS OF WORK

DESCRIPTION OF ITEMS	N.Y. STATE SPEC. ITEM
DISMANTLING AND STORING EXISTING SUPERSTRUCTURES-(REMOVE EXISTING WOODEN FOOT BRIDGE-PARTS NOT REQUIRED TO BE MATCH MARKED)	81
CLASSIFIED ROCK EXCAVATION-(CUTTING OFF EXISTING CONCRETE AT TOP OF DAM, CORNERS AND WHERE REQUIRED TO PROVIDE FINISHED PROFILE AND ALIGNMENT)	4
UNCLASSIFIED EXCAVATION-(DOWNSTREAM & UPSTREAM OF DAM-ROLLING NOT REQUIRED)	2
BAR REINFORCEMENT FOR STRUCTURES(⅜"ϕ HOOK BENT DOWELS & 1"ϕ ANCHOR RODS)	28
PNEUMATICALLY PROJECTED CONCRETE-(REINFORCED WITH GALVANIZED WELDED WIRE FABRIC IN FACES AND PIERS, ETC.)	111
MISCELLANEOUS METALS (W.I. BARS FOR FLASH BOARD PINS, ANGLE IRON, ETC.)	30
PREMOULDED BITUMINOUS JOINT-(FOR EXISTING VERTICAL EXPANSION JOINTS AT DAM)	M-36
ELASTIC CEMENT(AT VERTICAL EXPANSION JOINTS AT DAM)	M-34
RESET GATE & CONTROLS	
COPPER (16 OZ. COLD ROLLED SHEET) BAFFLES BENT TO SHAPE, WITH HOLES PUNCHED, FOR EXISTING VERTICAL EXPANSION JOINTS AT DAM.	C&BPA STD.

PLANS FOR REPAIRS TO DAM AT LAKE KANAWAUKE
HARRIMAN STATE PARK
ROCKLAND COUNTY N.Y.

DESIGNED BY	TITLE	DRAWING No.
DRAWN BY	PLAN, ELEVATION, SECTIONS AND DETAILS	
TRACED BY		
CHECKED BY		SCALE AS SHOWN
DATE 9/9/47		

PALISADES INTERSTATE PARK COMMISSION
BEAR MOUNTAIN NEW YORK

JOSEPH S. WARD AND ASSOCIATES
CONSULTING ENGINEERS
PHASE I - NATIONAL DAM SAFETY PROGRAM
LAKE KANAWAUKE DAM

PLATE IV JULY 1978

APPENDIX A

CHECKLIST - ENGINEERING DATA

CHECKLIST

HYDROLOGIC AND HYDRAULIC DATA

ENGINEERING DATA

NAME OF DAM: Lake Kanawauke   NDS ID NO.: NY58

RATED CAPACITY (ACRE-FEET) 1558   NYS DEC ID NO.: 196A-353

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 827.75

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): 827.75

ELEVATION MAXIMUM DESIGN POOL: 829.75

ELEVATION TOP DAM: 828.75

CREST (SPILLWAY):

a. Elevation 827.75
b. Type Concrete; rounded - crest
c. Width Not applicable
d. Length 242 feet
e. Location Spillover Central portion of dam
f. Number and Type of Gates None

OUTLET WORKS:

a. Type Low level sluiceway (tunnel)
b. Location 117 feet from right abutment
c. Entrance inverts 809±
d. Exit inverts 809±
e. Emergency draindown facilities 1

HYDROMETEOROLOGICAL GAGES:

a. Type None
b. Location None
c. Records None

MAXIMUM NON-DAMAGING DISCHARGE: Unknown; 2400 cfs (estimated)

CHECKLIST

ENGINEERING DATA

DESIGN, CONSTRUCTION, AND OPERATION
PHASE I

NAME OF DAM: Lake Kanawauke

NDS ID NO.: NY58 NYS DEC ID NO.: 196A-353

Sheet 1 of 5

ITEM	REMARKS
DRAWINGS	Two design drawings available 1) Original structure (1917) 2) Modifications (1947)
REGIONAL VICINITY MAP	Dam-lake system shown on USGS $7\frac{1}{2}$ minute quadrangle sheets of N.Y. 1) Sloatsburg, NY-NJ (N4107.5-W7407.5) 2) Thiells, N.Y. (N4107.5-W7400)
CONSTRUCTION HISTORY	No formal history available. Some information contained in internal memos of NYS Dept. of Conservation.
TYPICAL SECTIONS OF DAM	Available on 1947 drawing
HYDROLOGIC/HYDRAULIC DATA	Not available

ENGINEERING DATA

ITEM	REMARKS
OUTLETS: Plan Details Constraints Discharge Ratings	Structural section on both 1917 and 1947 drawings
RAINFALL/RESERVOIR RECORDS	None
DESIGN REPORTS	None
GEOLOGY REPORTS	None
DESIGN COMPUTATIONS: Hydrology & Hydraulics Dam Stability Seepage Studies	None

ENGINEERING DATA

ITEM	REMARKS
MATERIALS INVESTIGATIONS Boring Records Laboratory Field	None
POST-CONSTRUCTION SURVEYS OF DAM	None
BORROW SOURCES	Not applicable
MONITORING SYSTEMS	None
MODIFICATIONS	Crest modification and reinforced gunite cover done in 1947-1948. Modifications shown on 1947 design drawing.

ENGINEERING DATA

ITEM	REMARKS
HIGH POOL RECORDS	None - hearsay evidence from owner's personnel.
POST-CONSTRUCTION ENGINEERING STUDIES AND REPORTS	None
PRIOR ACCIDENTS OR FAILURE OF DAM Description Reports	None
MAINTENANCE AND OPERATION RECORDS	None
SPILLWAY: Plan Sections Details	Available on both 1917 and 1947 drawings.

ENGINEERING DATA

ITEM	REMARKS
OPERATING EQUIPMENT: Plans Details	Available on both 1917 and 1947 drawings.
PREVIOUS INSPECTION Date: Findings	Inspections are performed periodically by NYSDEC. The latest one was on 8 January 1975: "No defects observed beyond normal maintenance."

APPENDIX B

CHECKLIST - VISUAL INSPECTION

CHECKLIST

VISUAL INSPECTION

PHASE I

NAME OF DAM: Lake Kanawauke County: Rockland State: N.Y. NDS ID No.: NY58

NYS DEC ID No.: 196A-353

Type of Dam: Concrete gravity Hazard Category: High

Date(s) Inspection: 22 June 1978
7 July 1978 Weather: Partly Cloudy Temperature: $75^{o}F$

Pool Elevation at Time of Inspection: 827.8 msl

Tailwater at Time of Inspection: 809.5 msl

Inspection Personnel:

E. A. Nowatzki (JSW)	F. Sansonetti (PIPC)
G. S. Salzman (JSW)	P. A. Gossen (LZA)
P. Sevik (PIPC)	

E. A. Nowatzki Recorder

Remarks:

There had been locally heavy thunder showers in the area the previous night so the ground was quite wet.

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
ANY NOTICEABLE SEEPAGE	No seepage noticeable on ground. Joints look tight where water was not flowing over spillway.	
JUNCTION OF STRUCTURE WITH Abutment Embankment Other Features	Junction of structure with abutments OK. Downstream erosion near abutments indicates that water went over dam or around abutments some (Refer to Sheet 3)	
DRAINS	None	
WATER PASSAGES	Sluice gate opened - OK. Looks like water overtopped dam and/or flowed around abutments in the past. No serious erosion.	
FOUNDATION	Not visible.	

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE SURFACES: Surface Cracks Spalling	Deterioration of concrete observed; severe to very severe scaling of piers; small to large spalls, (Refer to Sheet 3)	The concrete deterioration does not seem to pose any danger, but the spalls on the downstream face and the (Refer to Sheet 3)
STRUCTURAL CRACKING	Longitudinal cracking on face of dam. Can't tell if it extends below gunite.	
VERTICAL AND HORIZONTAL ALIGNMENT	OK (vertical) OK (horizontal)	
MONOLITH JOINTS	Not visible. The monolith joints are covered by 17" wide copper baffle strips that serve as joints for gunite construction.	
CONSTRUCTION JOINTS	Longitudinal joints along top of dam look OK. These are gunite joints. Monolith joints not visible. (Refer to GUNITE JOINTS, Sheet 3)	
RECORDING INSTRUMENTATION	None.	

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
JUNCTION OF STRUCTURE WITH Abutment Embankment Other Features	time ago. Right abutment rests on visible rock outcrop Left abutment probably also rests on rock which seems to be within a few feet of surface based on outcrops observed nearby.	
CONCRETE SURFACES: Surface Cracks Spalling	mostly in gunite on downstream face; slight scaling in original dam visible through spalls in gunite. Wire mesh reinforcement in gunite is badly corroded.	very severely scaled piers and outlet tunnel should be repaired.
GUNITE JOINTS	Not all joints visible. On downstream face of dam caulking eroded on joints near middle of dam. Joints look tight in section where no water was coming over spillway.	
OTHER	Water supply pipeline crosses dam below wooden walkway.	

OUTLET WORKS

Sheet 1 of 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	Severely spalled and cracked at outlet.	
INTAKE STRUCTURE	Not visible.	
OUTLET STRUCTURE	See comment above.	
OUTLET CHANNEL	Contains rocks, boulders, vegetation. Normal channel is small stream which begins at exit of outlet conduit. Much debris.	
EMERGENCY GATE	Gate not visible. Controls function well. Gate can be fully opened in about 15 to 20 minutes.	

UNGATED SPILLWAY

Sheet 1 of 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	In good condition; evidence of slight scaling. Debris hung up on rusted flashboard pegs.	
APPROACH CHANNEL	None.	
DISCHARGE CHANNEL	See comments on Sheet 1 of Outlet Works under "Outlet Channel".	
BRIDGE AND PIERS	Wooden bridge in good condition, leads to gate controls. Piers badly deteriorated; steel visible.	

INSTRUMENTATION

Sheet 1 of 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	None	
OBSERVATION WELLS	None	
WEIRS	None	
PIEZOMETERS	None	
OTHER	None	

RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	About 2 horizontal to 1 vertical along the right (western) shore. About 4 horizontal to 1 vertical along the left (eastern) shore. Heavily (See below)	
SEDIMENTATION	Nominal - measurements not available. No noticeable sediment in discharge from sluiceway.	No sediment noticed by personnel when lake was lowered 14 feet recently.
OTHER	Government land for recreational use; protected from residential or business development.	
SLOPES	vegetated. Several camps along shoreline. No evidence of large scale slope failure; some small local scars noted on air photos.	

DOWNSTREAM CHANNEL

Sheet 1 of 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION Obstructions Debris Other	Boulders and a few trees in channel. Trees on slopes. Considerable amount of debris at toe of dam.	
SLOPES Cover Stability	Approximately same grade and condition (cover) as upstream slopes. No evidence of large scale slope failure.	
APPROXIMATE NUMBER OF HOMES AND POPULATION	Popular recreational area and beach within ½ mile downstream of dam. Camping cabins scattered throughout area. Permanent housing about a mile or two downstream of Sebago	
	Beach. Sloatsburg (pop. 3400) about 6½ miles downstream.	

APPENDIX C

HYDRAULIC AND HYDROLOGICAL COMPUTATIONS

By ENW Date 6/20/78

Subject Lk Kanawauke Dam

JOSEPH S. WARD, INC.
91 ROSELAND AVENUE
BOX 91
CALDWELL, N.J. 07006

Job # A1805-11
Sheet 1 of 6

Classification of Dam

H < 20'

Storage (from permit application) = 52,200,000 ft³ ≈ 1200 ac-ft
(from PIPC summary) = 507,641,250 gals ≈ 1558 ac-ft

2 | 2758
1379

Use 1400 acre feet

Dam is "intermediate" size.

Lake Kanawauke Dam

JOSEPH S. WARD, INC.
91 ROSELAND AVENUE
BOX 91
CALDWELL, N.J. 07006

19 June 1978
A 7805-11
By ETN

p 2 of 6

CHKD BY SRR 7/7/78

Flow through sluiceway - assume its flowing full and Manning coef = 0.013

1) With headwater at El 827.75
Assume sluiceway invert at El 809.0

$0.9 D = 2.7'$

$H_T = 827.75 - (809.0 + 2.7') \doteq 16$ ft.

Length $L \cong 72'$

Assume entrance loss $K_e = 0.5$

From Chart take (Sheet 4)

$Q \cong 200$ cfs

2) With headwater at El 829.75

$H_T = 18$ ft
$L = 72$ ft
$K_e = 0.5$

From Chart

$Q \cong 220$ cfs.

Total flow

1) Consider flow over spillway when pool is El 829.75 elevation

$L = L' - 2(NK_p + K_a)H_e$

$L' = 242'$
$N = 19$
$K_p = 0$
$K_a = 0.1$
$H_e = 2'$

Reference BU.REC Design of Small Dams p 373

$L = 242' - 2(19(0) + 0.1)2$
$L = 242' - 0.4 = 241.6'$

Lake Kanawauke Dam

19 June 1978
A7805-11
SEAN
p3 of 6
CHKD
SRR
7/7/78

2) Consider flow over dam portion when pool is at

Effective length of dam to right of spillway = 34'

" " " " left " = 18'

52'

Number of piers — 4

$L = 52 - 2(4(0) + 0.1)1' = 52 - 0.2 = 51.8'$

3) Compute flow over length of dam by

$Q = C_d L H_c^{3/2}$

C_d (spillway) $= 3.22 + 0.4\left(\frac{H_c}{P}\right) = 3.22 + 0.4\left(\frac{2}{20}\right) = 3.26$

C_d (dam) $= 3.22 + 0.4\left(\frac{1}{21}\right) = 3.24$

$Q = 3.26(241.6)(2)^{3/2} + 3.24(51.8)(1)^{3/2}$

$Q = 2228 + 168 \cong$ 2400 cfs ok

4) $Q_T = 2400 + 220 \cong 2600$ cfs

Consider flow over spillway only

$C_d = 3.22 + 0.4\left(\frac{1}{20}\right) = 3.24$

$Q = 3.24(241.6)(1)^{3/2} = 783$ cfs.

JOSEPH S. WARD, INC.
91 ROSELAND AVENUE
BOX 91

Sheet 4 of 6

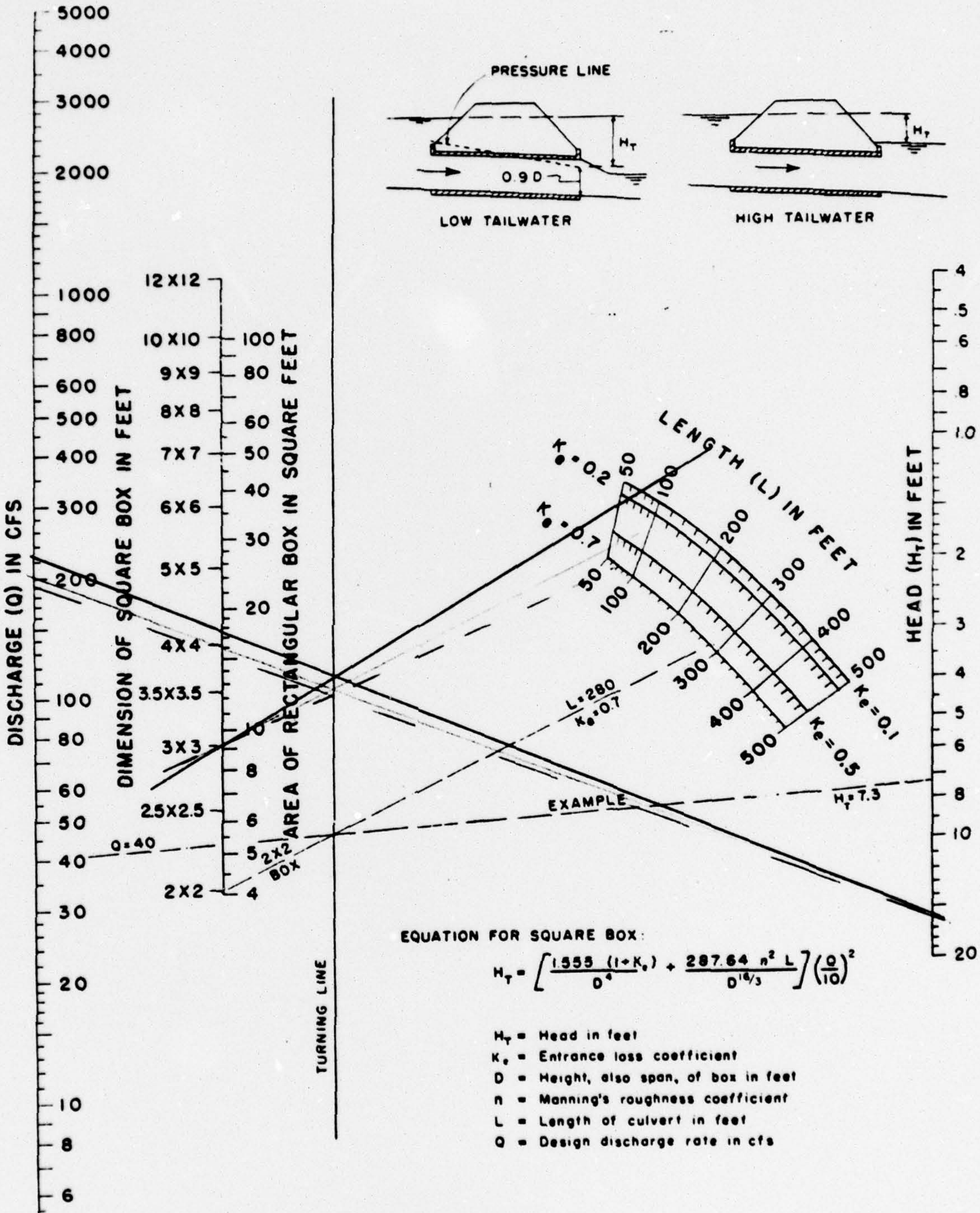


Figure 8–13. Head for concrete box culverts flowing full, n=0.013. (U.S. Bureau of Public Roads.) 288–D–2913.

BY EAN DATE 7/6/78 **JOSEPH S. WARD** SHEET NO. 5 OF 6
CHKD. BY ADD DATE 7/11/78 91 ROSELAND AVE. CALDWELL, N. J. JOB NO. 47305-11
SUBJECT Lake Kanawauke - Hydrology

From p 201 of USACE Model Study LHR

Subarea	Area (mi^2)	SPF	TA (Transposed Agnes)
2	18.4	6589 cfs	3417 cfs

$$\left(\frac{DA_1}{DA_2}\right)^{0.75} = \left(\frac{F_1}{F_2}\right)$$

From PIPC summary sheet for Lake Kanawauke, DA = 3040 acres = 4.75 mi^2

$$\left(\frac{4.75}{18.4}\right)^{0.75} = \left(\frac{F_1}{6589}\right) \quad \text{or} \quad \left(\frac{5.0}{18.4}\right)^{0.75} = \left(\frac{F_1}{6589}\right)$$

Assume 2450 $\begin{cases} F_1\ (SPF) = 0.362\,(6589) = 2385 \cong 2400 \text{ cfs} \\ F_1\ (SPF) = 0.376\,(6589)\quad 2481 \text{ cfs for } DA_1 = 5\ mi^2 \end{cases}$

Assume 1270 $\begin{cases} F_1\ (TA) = 0.362\,(3417) = 1237 \cong 1250 \text{ cfs} \\ F_1\ (TA) = 0.376\,(3417) = 1286 \text{ cfs for } DA_1 = 5\ mi^2 \end{cases}$

$$Q = C_1 L H_e^{3/2}$$

$$Q\,(TA) = 3.26\,(241.6)(1.50)^{3/2} \cong 1450 \text{ cfs.}$$

Assume max pool is when water is at top of abutment seats (El 829.75). This is 2 feet above normal pool at spillway crest (El 827.75)

Assume general slope of shoreline is 0.233 and length of shore line is 5.73 miles (see PIPC summary sheet). Also assume size of lake at normal pool is 186 acres (see PIPC sheet)

Volume Change $= \left[2' \times \frac{1}{0.233}\right] \times \frac{1}{2} \times 2' \times 5.73 \text{ miles} \times \frac{5280 \text{ ft}}{\text{mile}} \times \frac{1 \text{ acre}}{43560 \text{ ft}^2}$

$+ 2' \times 185.5 \text{ acres} = 377$ acre feet

∴ Storage capacity at max pool = storage capacity at normal pool + ΔV

Compute change in surface area (surface area at normal pool ≠ 185.5 acres

a) Top of dam

$\left(\frac{1}{0.233}\right) \text{ft} \times 5.73 \text{ miles} \times 5280 \frac{\text{ft}}{\text{mile}} \times \frac{1 \text{ acre}}{43560 \text{ ft}^2} \cong 3$ acres

b) Top of abutment seat

2 (value for top of dam) ≅ 6 acres

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BY JD DATE 6/28/78	SUBJECT HYDROLOGY	SHEET NO. 1 OF 9
CHKD. BY SRR DATE 7/7/78	LAKE KANAWAUKE	JOB NO. 78-353
	SAFETY INSPECTION	A-7905-11

DETERMINATION OF PEAK INFLOWS

TRANSPOSE DATA FOR SUB-AREA 2

LAKE KANAWAUKE = A_1 = DRAINAGE AREA = 5 sq mi (FROM ORIG. APPLIC 9/3/24)

RAMAPO R.
SUB AREA 2 = A_2 = 18.4 sq mi (P 178 "LOWER HUDSON RIVER" - FLOOD ROUTING MODEL)

SPF_2 = 6589 cfs (p201 "LHR")
$PMF_2 = 2(SPF_2)$ = 13,178 cfs (CONTACT w/ MR T. SMYTH ACE)

GENERAL TRANSPOSITION FORMULA (contact w/ MR THOMPSON, ACE)

$$\left(\frac{A_1}{A_2}\right)^{0.75} = \frac{SPF_1}{SPF_2} \text{ or } \frac{PMF_1}{PMF_2}$$

$$\left(\frac{5}{13.4}\right)^{0.75} = 0.376$$

$SPF_1 = 0.376(6589)$ $PMF_1 = 0.376(13,178)$

SPF_1 = 2477 cfs PMF_1 = 4955 cfs

$$\boxed{\text{PMF for LAKE KANAWAUKE } 4955 \text{ cfs}}$$

OVETOPPING POTENTIAL

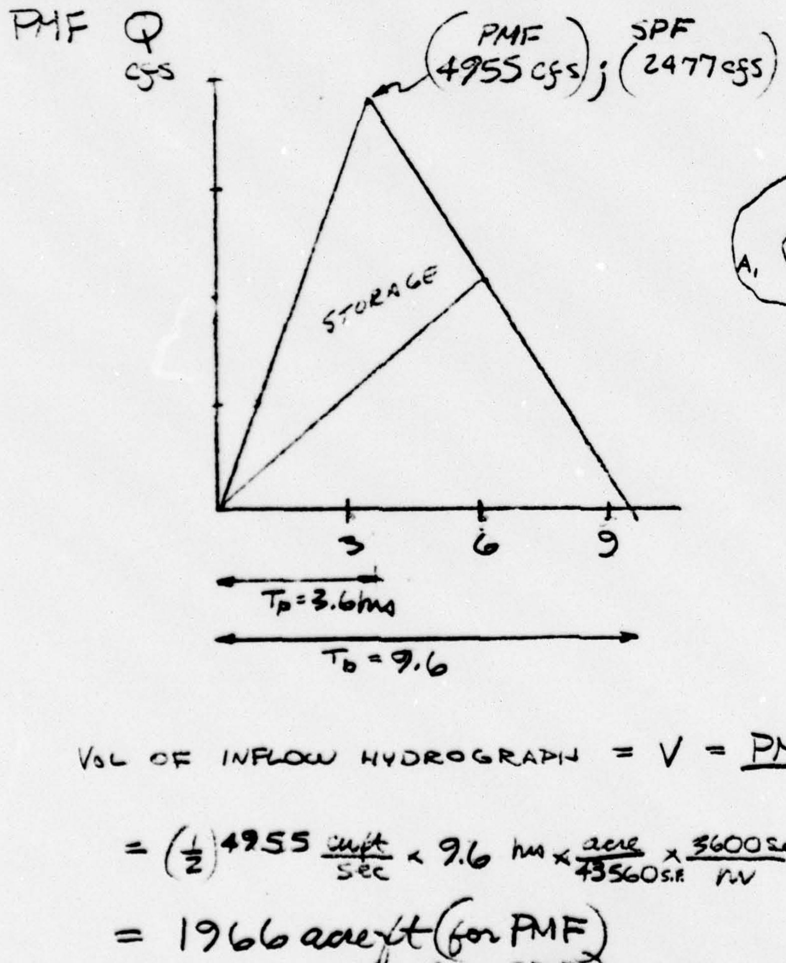
Q_1 = MAX. SPILLWAY CAPACITY = 2400 cfs

Q_2 = PMF PEAK INFLOW = 4955 cfs

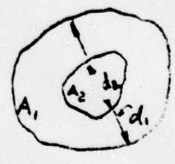
p_{PMF} = % of PMF SPILLWAY WILL PASS ; % OF SPF WILL PASS

$p = \frac{Q_1}{Q_2} = \frac{2400}{4955} = 48\%$ $p_{SPF} = \frac{2400}{2477} = 97\%$

$\therefore (1-p) = \frac{\text{REQ. RESEVOIR STORAGE}}{\text{VOL. OF INFLOW HYDROGRAPH}} = 0.52$ (for PMF)
0.03 (for SPF)



SOLVE – Tp for TRIANGULAR HYDR.
ASSUME Tp IS A FUNCTION OF THE LINEAR ELEMENTS OF EQUIVALENT AREAS



$A_1 = 18.4^* = \frac{\pi}{4} d_1^2$ $T_{P_1} = 6.9^*$ hrs
$d_1 = 4.84$

$A_2 = 5 = \pi \frac{d_2^2}{4}$ $T_{P_2} = ?$
$d_2 = 2.52$

$T_{P_2} = \frac{d_2}{d_1} T_{P_1} = \frac{2.52}{4.84}(6.9)$

$T_{P_2} = 3.6$ hrs

$T_b = 2.67^{**}(T_P) = 9.6$ hrs

VOL OF INFLOW HYDROGRAPH $= V = \frac{PMF \times T_b}{2}$

$= \left(\frac{1}{2}\right) 4955 \frac{\text{cu ft}}{\text{sec}} \times 9.6 \text{ hrs} \times \frac{\text{acre}}{43560 \text{ s.f.}} \times \frac{3600 \text{ sec}}{\text{hr}}$

= 1966 acre ft (for PMF)
= 983 acre ft (for SPF)

* LOWER HUDSON RIVER FLOOD ROUTING MOD. p 198

** DESIGN OF SMALL DAMS p69.

PURCELL ASSOCIATES

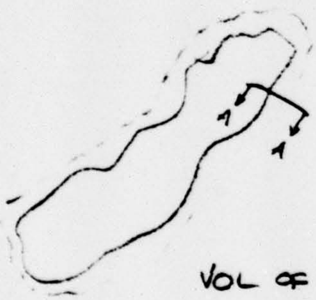
REQ. RESERVOIR STORAGE = 0.52 (1966) ; 0.03 (983)
= 1022 acre-ft (for PMF)   30 acre-ft (for SPF)

INCREMENTAL STORAGE AVAILABLE = DIFFERENCE BETWEEN NORMAL POOL ELEVATION AND MAX. POOL ELEV.

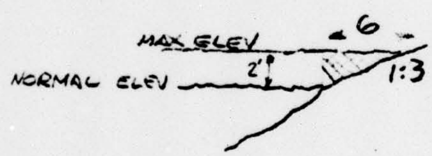
NORMAL POOL ELEV. = 827'.75
MAX POOL ELEV. = 829.75
DIFF = 2.00 ft

NORMAL RESERVOIR AREA = 185.5 ACRES (PIP SUMMARY)

LENGTH OF SHORE LINE = 5.73 mi (PIP SUMMARY)
ASSUME SHORELINE SLOPE = 1V : 3H



SECTION A-A



$$\text{VOL OF SEC} = \left(\frac{6 \times 2}{2}\right) ft^2 \times 5.73\,mi \times \frac{5280\,ft}{mi} \times \frac{1\,acre}{43560\,ft^2}$$
$$= 4.2\ \text{acre ft}$$

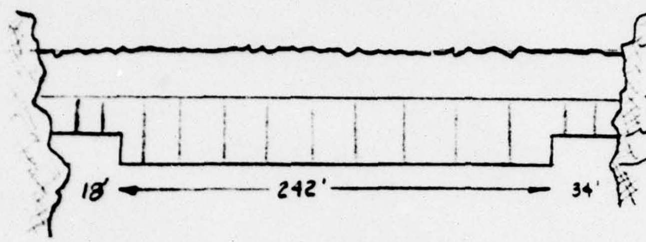
TOT. INCREMENTAL STOR. = 2' x 185.5 acres + 2.78 acre-ft
= 373.8 acre-ft
say 375 acre-ft AVAILABLE

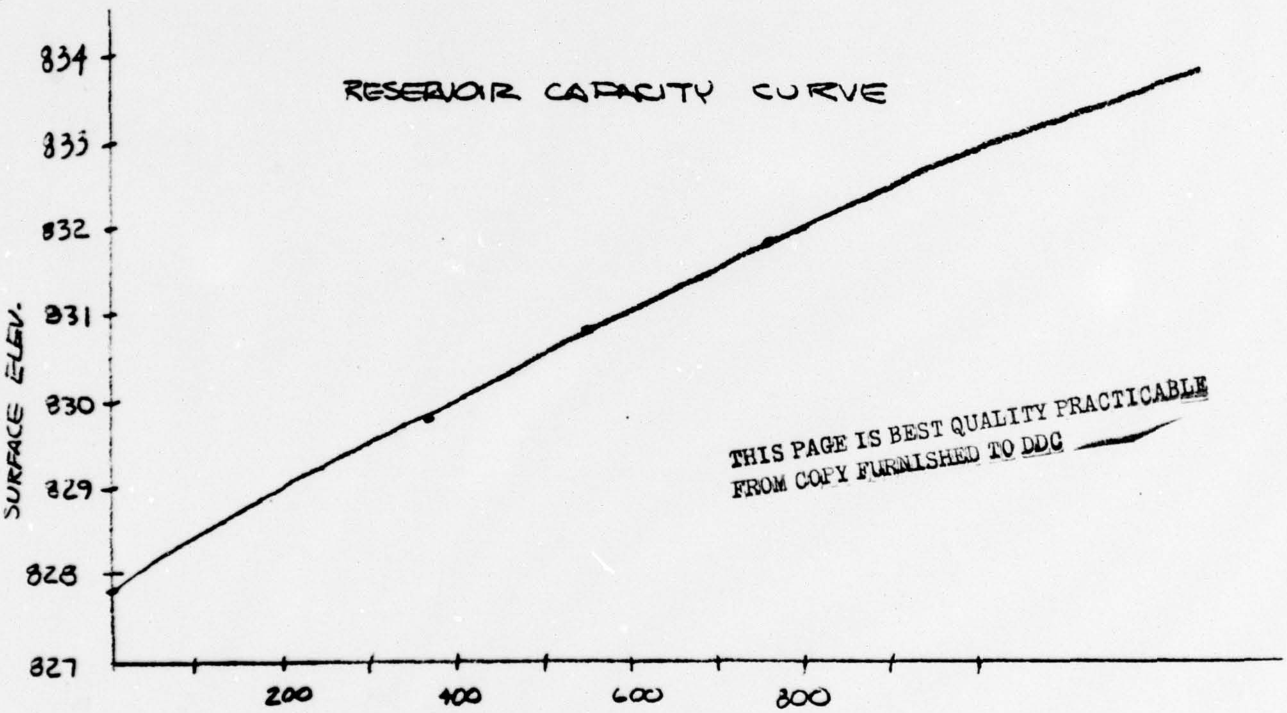
375 < 1022 acre-ft (for PMF)   375 > 30 acre-ft (for SPF)

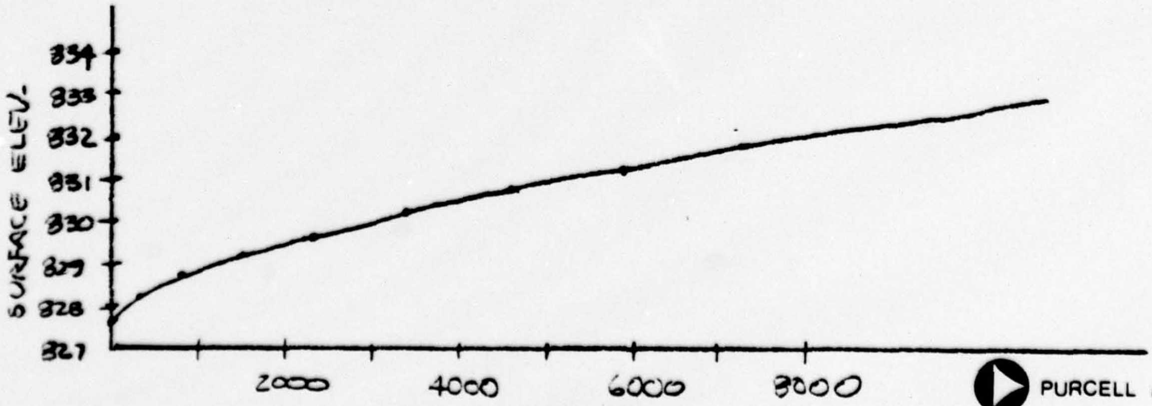
∴ LAKE KANAWAUKE WILL NOT BE ABLE TO CONTAIN THE PMF WITHOUT OVERTOPPING.
BUT L. KINAWAUKE WILL BE ABLE TO CONTAIN THE SPF WITHOUT OVERTOPPING

BY J.D. DATE 7/6/78 SUBJECT HYDROLOGY - LAKE KANAWAUKE DAM SAFETY INSPECTION SHEET NO. 4 OF 9
CHKD. BY ______ DATE ______ JOB NO. 78-353 A7305-11

THE FOLLOWING FLOOD ROUTING WILL BE USED TO DETERMINE POOL ELEV AT PMF.







PURCELL ASSOCIATES

DISCHARGE ϕ (cfs)

$\phi = Q_1$ (SPILLWAY) $+ Q_2$ (DAM)

$= C_{d_1} L_1 H_{e_1}^{3/2} + C_{d_2} L_2 H_{e_2}^{3/2}$

GIVEN:
$L_1 = 241.6'$ (See HYDRAULIC COMPS BY EAN)
$L_2 = 51.8'$
$H_{e_1} = H_{e_2} + 1$

$C_d = 3.22 + 0.4\left(\frac{H_e}{P}\right)$

$P_1 = 20'$; $P_2 = 21'$

for $H_{e_1} \rightarrow \phi$ (cfs) =

0.5' $= \left[3.22+0.4\left(\frac{0.5}{20}\right)\right]241.6(0.5)^{3/2} + \left[3.22+0.4\left(\frac{0}{21}\right)\right]51.8(0)^{3/2}$

276 = 276 + 0

1.0' $= \left[3.22+0.4\left(\frac{1.0}{20}\right)\right]241.6(1)^{3/2} + \left[3.22+0.4\left(\frac{0}{21}\right)\right]51.8(0)^{3/2}$

783 = 783 + 0

1.5' $= \left[3.22+0.4\left(\frac{1.5}{20}\right)\right]241.6(1.5)^{3/2} + \left[3.22+0.4\left(\frac{0.5}{21}\right)\right]51.8(0.5)^{3/2}$

1502 = 1443 + 59

2.0 $= \left[3.22+0.4\left(\frac{2.0}{20}\right)\right]241.6(2)^{3/2} + \left[3.22+0.4\left(\frac{1}{21}\right)\right]51.8(1)^{3/2}$

2396 = 2228 + 168

2.5 $= \left[3.22+0.4\left(\frac{2.5}{20}\right)\right]241.6(2.5)^{3/2} + \left[3.22+0.4\left(\frac{1.5}{21}\right)\right]51.8(1.5)^{3/2}$

3432 = 3123 + 309

3.0 $= \left[3.22+0.4\left(\frac{3.0}{20}\right)\right]241.6(3)^{3/2} + \left[3.22+0.4\left(\frac{2}{21}\right)\right]51.8(2)^{3/2}$

4595 = 4118 + 477

3.5 $= \left[3.22+0.4\left(\frac{3.5}{20}\right)\right]241.6(3.5)^{3/2} + \left[3.22+0.4\left(\frac{2.5}{21}\right)\right]51.8(2.5)^{3/2}$

5874 = 5205 + 669

4.0
7260 $= \left[3.22+0.4\left(\frac{4}{20}\right)\right]241.6(4)^{3/2} + \left[3.22+0.4\left(\frac{3}{21}\right)\right]51.8(3)^{3/2}$

6379 + 882

BY JD DATE 7/5/78 SUBJECT HYDROLOGY SHEET NO. 6 OF 9
CHKD. BY SRR DATE 7/5/78 DAM SAFETY INSPECTION JOB NO. 78-353
LAKE KANAWAUKE A-7805-11

FLOOD STORAGE VS ELEV.

LAKE AREA @ POOL ELEV = 185.5 ACRE (see SHT 3)
ASSUME 1:3 SLOPE ON SHORE

FOR ELEV

$He \rightarrow \therefore VOL = (ELEV)(185.5) + \left[\frac{(ELEV)(3 \times ELEV)}{2} \times \text{Length of shore} \times \frac{5280\text{ ft}}{1\text{ mi}} \times \frac{1\text{ acre}}{43560}\right]$ (SLOPE OF SHORE LINE)

0.5' $= 0.5(185.5) + \left[\frac{(0.5)3(0.5)}{2} \times \frac{5.73 \times 5280}{43.560}\right]$

$\checkmark$ 93 acft $= 92.8 + [0.375 \times 0.695]$

1.0' $= 1(185.5) + \left[\frac{1(3)1}{2} \times 0.695\right]$

$\checkmark$ 187 acft $= 185.5 + 1.04$

1.5' $= 1.5(185.5) + \left[\frac{1.5(3)1.5}{2} \times .695\right]$

$\checkmark$ 280 acft $= 278 + 2.3$

2.0' $= 2(185.5) + \left[\frac{(2)3(2)}{2} \times .695\right]$

$\checkmark$ 375 acft $= 371 + 4.2$

2.5' $= 2.5(185.5) + \left[\frac{2.5(3)2.5}{2} \times (.695)\right]$

$\checkmark$ 470 acft $= 463.8 + 6.5$

3.0' $= 3(185.5) + \left[\frac{(3)(3)(3)}{2} \times .695\right]$

$\checkmark$ 566 acft $= 556.5 + 9.4$

3.5' $= 3.5(185.5) + \left[\frac{(3.5)(3)(3.5)}{2} .695\right]$

$\checkmark$ 662 acft $= 649.3 + 12.8$

4.0' $= 4(185.5) + \left[\frac{4(3)4}{2} .695\right]$

$\checkmark$ 759 acft $= 742 + 16.7$

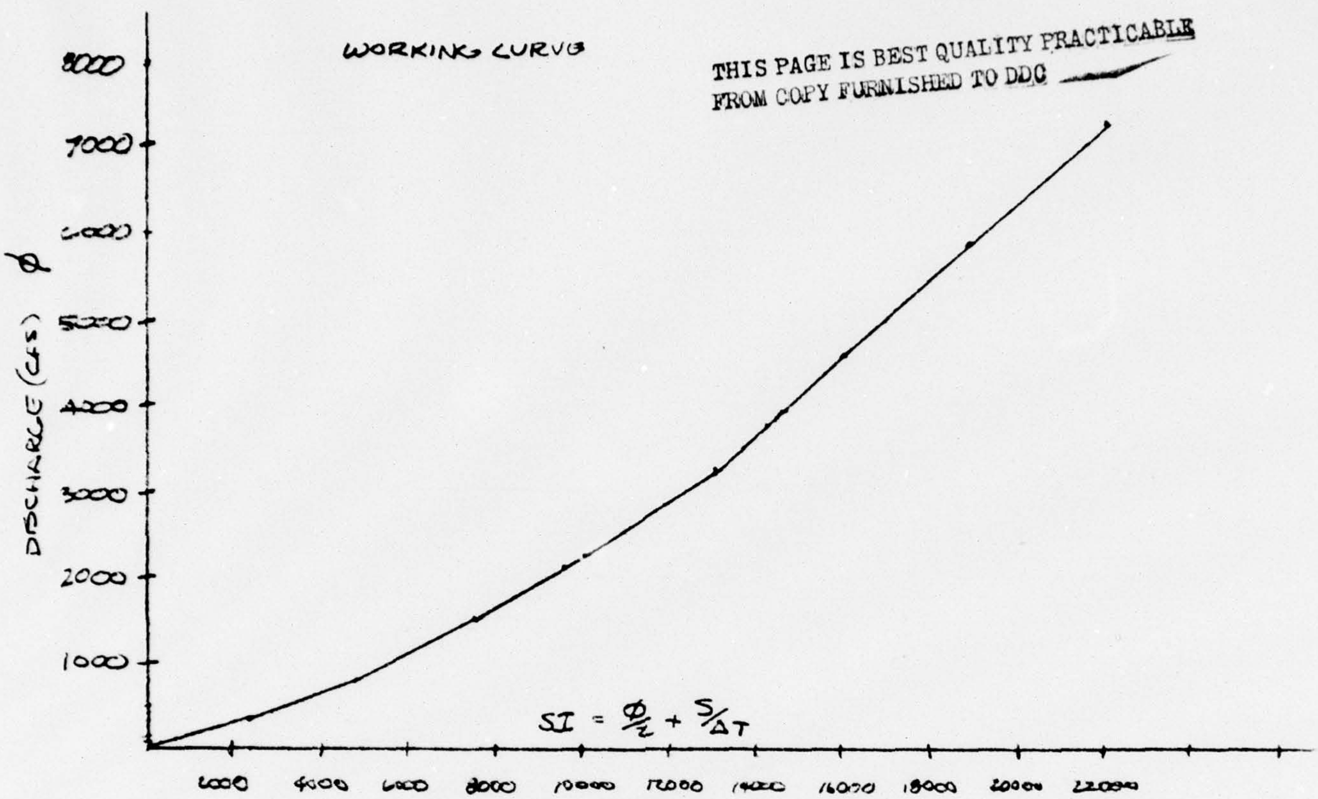
BY: ID DATE: 7/6/78 SUBJECT: HYDROLOGY SHEET NO. 7 OF 9
CHKD. BY: SRR DATE: 7/27/78 LAKE KANAWAUKE JOB NO. 78-353
DAM SAFETY INSPECTION A-7805-11

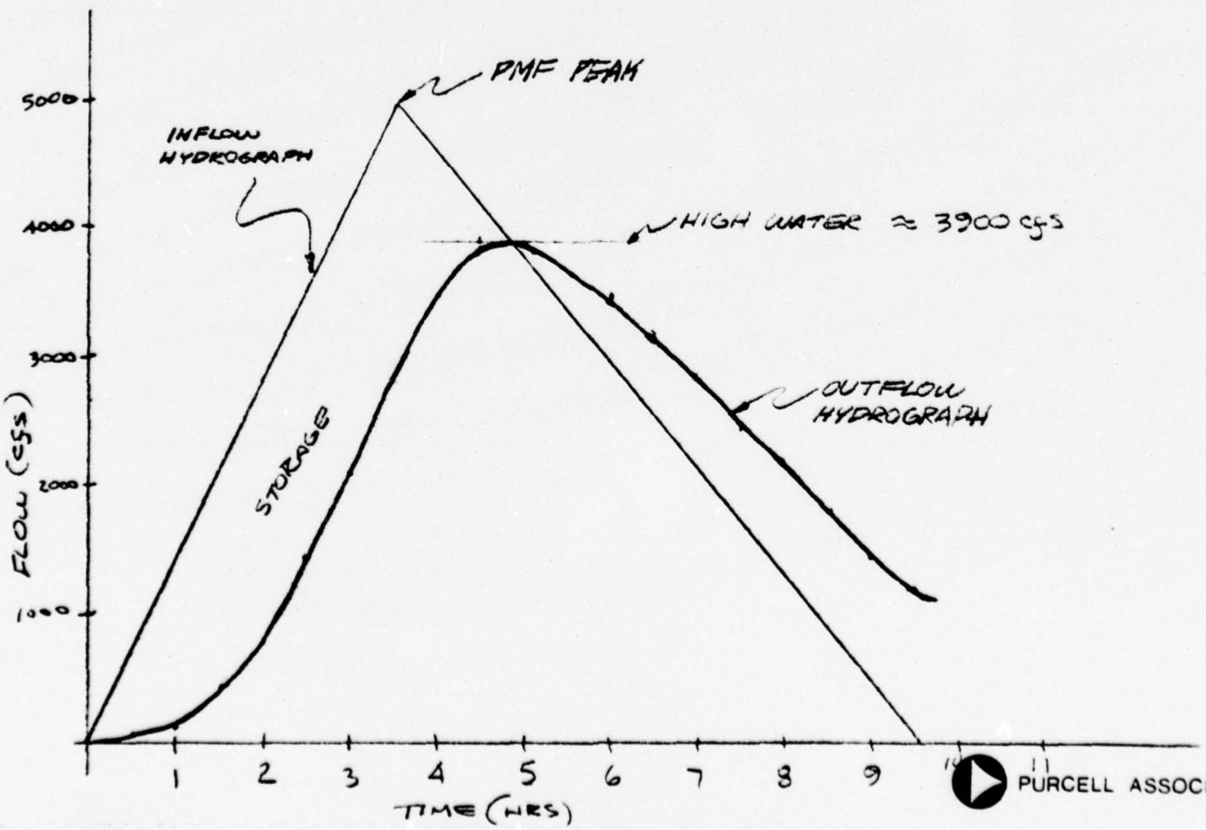
ELEV (ft)	ϕ (cfs)	$\phi/2$ (cfs)	Flood Stor. Acre-ft.	Flood Stor. S cfs-hrs.	$S/\Delta T$ (0.5 hr)	$SI = \frac{\phi}{2} + \frac{S}{\Delta T}$
pool	0	0	0	0	0	0
828.25	276	138	93	1125	2250	2388
828.75	783	392	187	2263	4526	4918
829.25	1502	751	280	3390	6780	7531
829.75	2396	1198	375	4575	9150	10348
830.25	3432	1716	470	5688	11,376	13092
830.75	4595	2298	566	6850	13,700	15998
831.25	5874	2937	662	8010	16,020	18957
831.75	7260	3630	759	9200	18400	22030

TIME (HRS)	I (cfs)	$\bar{I}$		$(SI)_N$	-	ϕ		$(SI)_N - \phi_N$
0	0	0		0	(-)	0	$I = \phi$	0 - 0 + 344 = 344
0.5	688	(+) 344	=	344	curve →	75		344 - 75 + 1032 = 1301 ✓
1	1376	1032		1301		110		1301 - 110 + 1720 = 2911 ✓
1.5	2065	1720		2911		450		2911 - 450 + 2408 = 4869 ✓
2	2752	2408		4869		775		4869 - 775 + 3096 = 7190 ✓
2.5	3440	3096		7190		1450		7190 - 1450 + 3785 = 9525 ✓
3	4129	3785		9525		2100		9525 - 2100 + 4473 = 11,898
3.5	4817	4473		11,898		2850		11898 - 2850 + 4680 = 13728 ✓
4	4542	4680		13728		3500		13728 - 3500 + 4336 = 14564 ✓
4.5	4130	4336		14564		3900		14564 - 3900 + 3923 = 14587 ✓
5	3716	3923		14587		3850		14587 - 3850 + 3510 = 14247 ✓
5.5	3303	3510		14247		3580		14247 - 3580 + 3096 = 13763 ✓
6	2390	3096		13763		3500		13765 - 3500 + 2684 = 12947 ✓
6.5	2477	2684		12947		3200		12947 - 3200 + 2271 = 12018 ✓
7	2065	2271		12018		2880		12013 - 2880 + 1858 = 10996 ✓
7.5	1652	1858		10996		2500		10996 - 2500 + 1445 = 9941 ✓
8	1238	1445		9941		2220		9941 - 2220 + 1032 = 8753 ✓
8.5	826	1032		8753		1800		8753 - 1800 + 619 = 7572 ✓
9	412	619		7572		1500		7572 - 1500 + 206 = 6278 ✓
9.5	0	206		6278		1200		

PURCELL ASSOCIATES

BY: JD DATE: 7/6/78 SUBJECT: HYDROLOGY SHEET NO. 8 OF 9
CHKD. BY: SRR DATE: 7/7/78 LAKE KANAUWAUKE JOB NO. 78-353
DAM SAFETY INSPECTION A-7805-11





PURCELL ASSOCIATES

BY JD DATE 7/6/78 SUBJECT HYDROLOGY & HYDRAULICS SHEET NO. 9 OF 9
CHKD. BY SRB DATE 7/7/78 LAKE KANAWAUKE JOB NO. 78-353
DAM SAFETY INSPECTION A 7805-11

(SPILLWAY) + (DAM)

$$Q = C_d L H_e^{3/2} + C_d L H_e^{3/2}$$

$Q = 3900$ MAX POOL

find H by trial & error.

$$Q_{2.7} = \left[3.22 + 0.4\left(\frac{2.7}{20}\right)\right] 241.6 (2.7)^{3/2} + \left[3.22 + 0.4\left(\frac{1.7}{21}\right)\right] 51.8 (1.7)^{3/2}$$

$= 3509 + 373$

$= 3882$ close enough

∴ The PMF WILL RAISE THE POOL TO $(2.7 + 827.75 = 830.45)$

830.45' THIS 0.70' above design elev. of 829.75'

APPENDIX D

PHOTOGRAPHS

FIGURE 1 SLUICE GATE CONTROLS

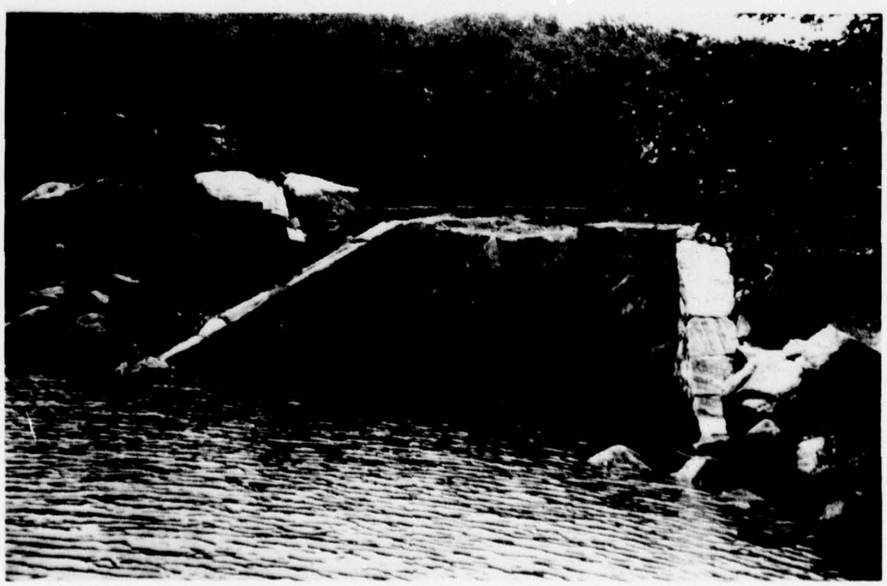


FIGURE 2 CONNECTING TUNNEL BETWEEN NORTHERN AND SOUTHERN PORTIONS OF LAKE KANAWAUKE

FIGURE 3 CRACKING AND SPALLING NEAR EXIT PORTAL OF SLUICE TUNNEL

FIGURE 4 SCALING OF CONTROL GATE PLATFORM

FIGURE 5 RIGHT ABUTMENT (UPSTREAM)

FIGURE 6 LEFT ABUTMENT (DOWNSTREAM)

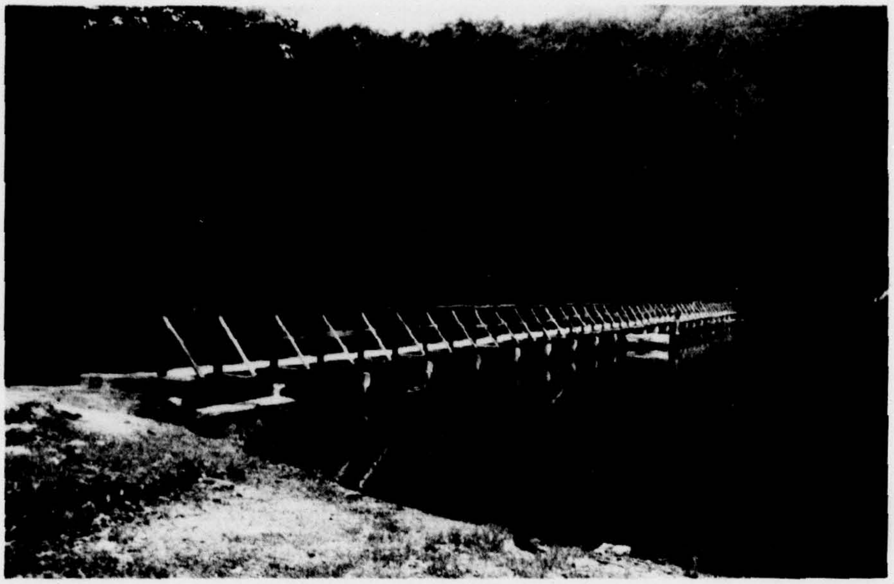


FIGURE 7 UPSTREAM VIEW OF LAKE KANAWAUKE DAM SHOWING WOODEN WALKWAY, GATE CONTROL PLATFORM AND LEFT ABUTMENT

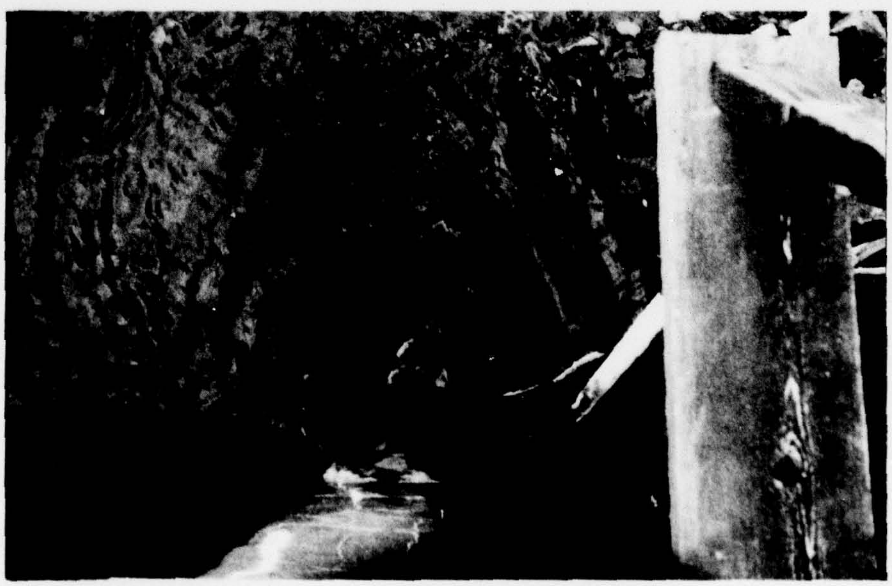


FIGURE 8 FLOW OUT OF SLUICE TUNNEL

FIGURE 9 OVERVIEW OF RESERVOIR SHOWING SIDE SLOPES

FIGURE 10 DOWNSTREAM CHANNEL

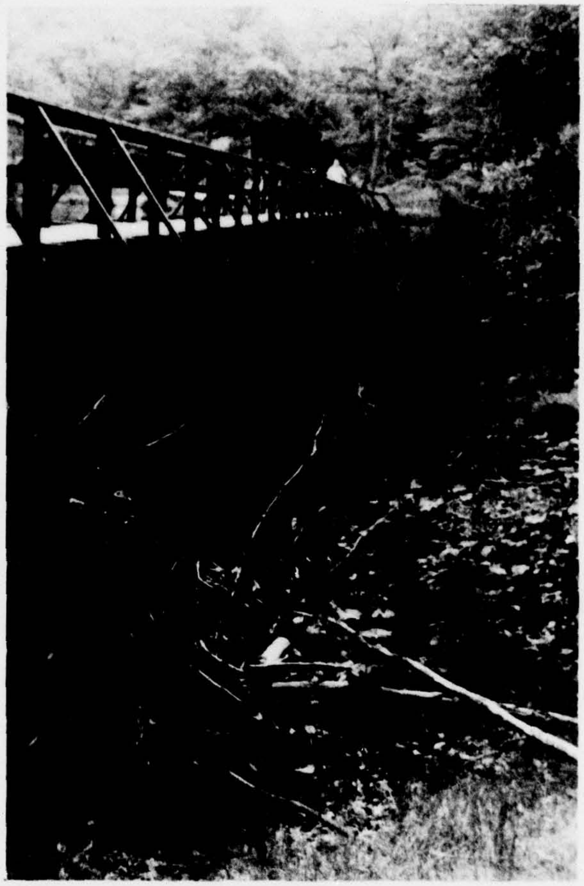


FIGURE 11   DEBRIS AT TOE OF DAM

FIGURE 12   DETENTION BASIN AND CONTROLS DOWNSTREAM FROM LAKE KANAWAUKE DAM

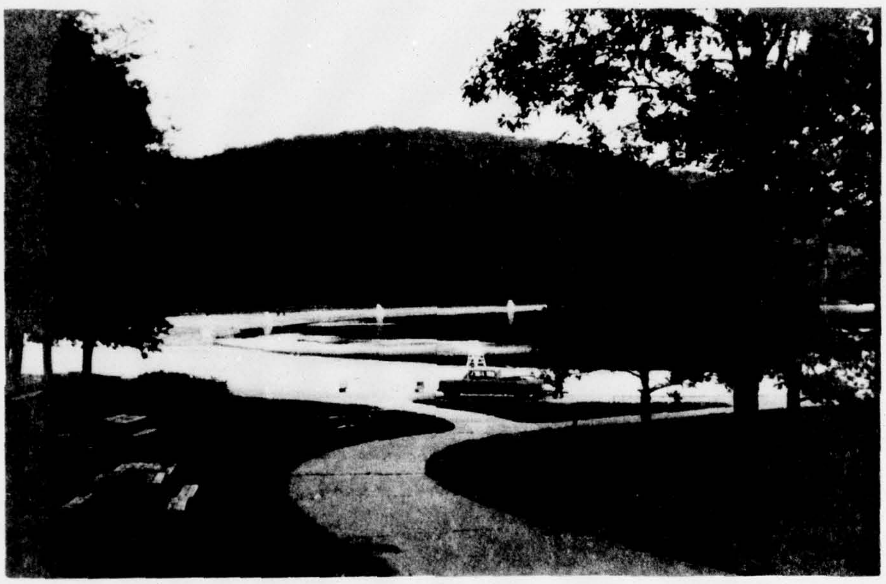


FIGURE 13 SEBAGO BEACH DOWNSTREAM FROM LAKE KANAWAUKE DAM

APPENDIX E

RELATED DOCUMENTS

3-28-24-1000 (6-4905)

STATE OF NEW YORK
DEPARTMENT OF

State Engineer and Surveyor

ALBANY

Received Sept 27 1926 Dam No. 353 L Hudson Watershed

Disposition Serial No.

Foundation inspected

Structure inspected

Application for the Construction or Reconstruction of a Dam

Application is hereby made to the State Engineer, Albany, N. Y., in compliance with the provisions of Chapter LXV of the Consolidated Laws and Chapter 647, Laws of 1911, Section 22 as amended, for the approval of specifications and detailed drawings, marked Dam #6. Lake Kanawauke - #226. #243.

herewith submitted for the {construction ~~reconstruction~~} of a dam located as stated below. All provisions of law will be complied with in the erection of the proposed dam. It is intended to complete the work covered by the application about (Date)

1. The dam will be on Stony Brook flowing into Ramapo River in the town of Haverstraw, County of Rockland and 6-1/4 miles northeast of Sloatsburg.
(Give exact distance and direction from a well-know bridge, dam, village main cross-roads or mouth of a stream)

2. The name and address of the owner is Palisades Interstate Park Commission.

3. The dam will be used for Lake for recreational use and landscape effect.

4. Will any part of the dam be built upon or its pond flood any State lands? All Park property.

5. The watershed at the proposed dam draining into the pond to be formed thereby is five square miles.

6. The proposed dam will have a pond area at the spillcrest elevation of 151 acres and will impound 52,200,000 cubic feet of water.

7. The lowest part of the natural shore of the pond is 1 foot vertically above the spillcrest, and everywhere else the shore will be at least 50 feet above the spillcrest.

8. The maximum known flow of the stream at the dam site was cubic feet per second on (Date)

9. State if any damage to life or to any buildings, roads or other property could be caused by any possible failure of the proposed dam considerable damage in the Ramapo Valley.

10. The natural material of the bed on which the proposed dam will rest is (clay, sand, gravel, boulders, granite, shale, slate, limestone, etc.) Gneiss ledge.

11. The material of the right bank, in the direction with the current, is Concrete gravity section dam; at the spillcrest elevation this material has a top slope of .... inches vertical to a foot horizontal on the center line of the dam, a vertical thickness at this elevation of .... feet, and the top surface extends for a vertical height of .... feet above the spillcrest.

12. The material of the left bank is ....; has a top slope of .... inches to a foot horizontal, a thickness of .... feet, and a height of .... feet.

13 State the character of the bed and the banks in respect to the hardness, perviousness, water bearing, effect of exposure to air and to water, uniformity, etc. impervious gneiss ledges, no crevises.

14. If the bed is in layers, are the layers horizontal or inclined? .... If inclined what is the direction of the horizontal outcropping relative to the axis of the main dam and the inclination and direction of the layers in a plane perpendicular to the horizontal outcropping ....

15. What is the thickness of the layers? ....

16. Are there any porous seams or fissures? No

17. WASTES. The spillway of the above proposed dam will be 204 feet long in the clear; the waters will be held at the right end by a concrete papapet the top of which will be 1 feet above the spillcrest, and have a top width of .... feet; and at the left end by a concrete parapet the top of which will be 1 feet above the spillcrest, and have a top width of .... feet.

18. There will be also for flood discharge a pipe .... inches inside diameter and the bottom will be .... feet below the spillcrest, a sluice or gate 3 feet wide in the clear by 3 feet high, and the bottom will be 20 feet below the spillcrest.

19. APRON. Below the proposed dam there will be an apron built of .... feet long across the stream, ... feet wide and .... feet thick. The downstream side of the apron will have a thickness of .... feet for a width of .... feet.

20. PLANS. Each application for a permit of a dam over 12 feet in height must be accompanied by a location map and complete working drawings in triplicate of the proposed structure, one set of which will be returned if they are approved. Each drawing should have a title giving the parts shown, the name of the town and county in which the dam site is located, and the name of the owner and of the engineer.

The location map (U. S. Geological Quadrangle or other map) should show the exact location of the proposed dam; of buildings below the dam which might be damaged by any failure of the dam; of roads adjacent to or crossing the stream below the dam, giving the lowest elevation of the roadway above the stream bed and giving the shape,

GEORGE D. PRATT, COMMISSIONER
ALEXANDER MACDONALD, DEPUTY COMMISSIONER
WARWICK S. CARPENTER, SECRETARY
MARSHALL McLEAN, SPECIAL DEPUTY ATTORNEY GENERAL

STATE OF NEW YORK

CONSERVATION COMMISSION

ALBANY

DIVISION OF FISH AND GAME
LLEWELLYN LEGGE, CHIEF
DIVISION OF LANDS AND FORESTS
C.R. PETTIS, SUPERINTENDENT
DIVISION OF WATERS
A. H. PERKINS, DIVISION ENGINEER
DIVISION OF SARATOGA SPRINGS
J. G. JONES, SUPERINTENDENT
SARATOGA SPRINGS, N.Y.

IN REPLYING PLEASE REFER TO FILE NUMBER
IN RE: DAM 353 L.H.

April 9, 1918.

Mr. A. H. Perkins, Division Engineer,
Conservation Commission,
P R E S E N T.

Dear Sir:-

In re. dam #353 Lower Hudson at Southfield, owned by Palisades Interstate Park Commission:

I inspected this dam on April 3d on account of complaint made by the Ramapo Mountains Water Power & Service Company, Inc., accompanied by Robert C. Reeves, secretary, and Joseph B. Rider, engineer of said company. They stated that in October 1917, when they last inspected the dam, it was only about 2 feet top width, straight on the upstream side and was bulged out about 18 inches at one place, and that the steepest part of the dam stood 35 feet above the bed. They both stated that since that time the dam has been thickened and straightened.

As built at present, the top width of the crest is 4 feet 6 inches, with a slope of 3-1/4 horizontal and 12 vertical on both the upstream and downstream faces. The west shore is steep and the east shore has a gentle slope. The west end has a non-overflow part 50 feet in length and 13 inches high. The east non-overflow part has not been built up above the crest level, so that the spillway crest extends from the west end about 200 feet to the east bank, which bank is covered with concrete waste from the concrete mixer. One section of the dam is unfinished and is 4 feet below the crest and about 30 feet long and this at the present is acting as a temporary spillway. The water level on the upstream side was up to the level of this temporary spillway. On the downstream side at the center, where it is the deepest, it has been filled in with rock up to a height of about 12 feet from the permanent spillway crest, and on ~~the~~ each side of this rock fill, sand has been placed. There is an emptying pipe with a culvert leading from same to a point 60 feet below the dam and this culvert is about 2 feet square. There are many granite outcroppings in the bed and the soil is a red clay earth with stones and rocks. No apron had been built, with the exception of the rocks piled in the middle of the dam. On account of the shape of the pond, with its gradual slope, there will probably be considerable ice pressure against the

dam and on account of the shape of the crest of the spillway, which is not rounded, there will probably be a vacuum caused on the downstream face.

In a letter of June 23, 1917 from Messrs. Blauvelt and Warren, counsel for the Palisades Interstate Park Commission, they stated that the Palisades Park Commission intended erecting no dams in the immediate future, and so the matter of the inspection of their dams by this Commission was dropped by them at that time. Nevertheless, this dam was at that time being constructed.

Respectfully yours,

Alex Rice McKim

INSPECTOR OF DOCKS AND DAMS.

McK:MH.

Complaint in re. dams on Stony Brook or tributaries
in Haverstraw Twp., Rockland Co., N. Y. - Constructed
or proposed by Palisades Interstate Park Commission. 1
J.W.H. Mar.19, 18
Water Supply Appl'n 110.217, by Jos. B. Rider,
Engr., in report dated Feb.19,1918, submitted Mar.4,
1918, at page 29.
Ck with PIPC for report. Not availab

"We are about to establish one or more stations on Stony Brook that we may obtain continuous weir, other stream, rainfall and other data and records, when we hope to obtain the exact factor for Stony Brook as applicable to Table 6.

Copies of these records will be delivered to your Commission from time to time, if so desired, in the hope they may aid others in hydraulic and other operations on similar streams.

Park Commission Reservoirs.

If the minimum in cu. ft. per second per square mile, for run-off as given in Table 6, should prove true for Stony Brook, or 0.151 as given for the month of July in next to the last column; then Mr. Vermule in estimating it at 0.2 sec. ft. per sq. mile has taken a figure for minimum run-off too high by 0.49 sec. ft. per sq. mile or high by 32.4%.

This means, then, that the evaporation from the reservoir proposed by the Palisades Interstate Park Commission above the Haverstraw line, would be greater than the minimum flow of the stream up to this point, as shown by the average for the three lowest calendar months; and to this extent would interfere with our operations and necessary storage in excess of that considered on page 5.

In addition to this reservoir, the Park Commission have already built another above Johnsontown on Stony Brook; its area I understand approximates 150 acres, or more.

It follows that (according to Mr. Vermule) if the 260 acre reservoir will take for evaporation all or more than the minimum flow of the stream; then two such reservoirs will double this item, and, on his basis, take 1.3 x 2 = 2.6 million gallons per day; three such reservoirs would take 3.9 millions per day, etc., and so on until the Park Commission could build, no more, on account of limitations in sites, for their "Canoe and swimming ponds".

We submit that such retention of the natural flow of the brook is not just, equitable or right to the public we are under contract to serve; and it makes our problem of so doing far more expensive; and uncertain as to how much storage we must provide, when denied the minimum flow, times one, two, or more, through the operations of the Park Commission.

In this connection, also, it is important that we take into consideration the design of structures for the retention of water of this brook.

In the summer of 1916, in company with Mr. Suter, assistant engineer of your Commission, I drove over the Stony Brook watershed, and we inspected a dam, then under construction by the Commissioners of the

Complaint in re. dams on Stony Brook or tributaries in Haverstraw Twp., Rockland Co., N. Y. - Constructed or proposed by Palisades Interstate Park Commission.

J.W.H. Mar. 9 18

Water Supply Appl'n 110,217 by Jos. B. Rider, Engr., in report dated Feb. 19, 1918, submitted Mar. 4, 1918, at page 29.

Palisades Interstate Park, which I understood (at the time) had not been approved by your Commission, in location or design. Since that time another large dam has been constructed on the stream by the Commission impounding, I judge, without accurate measurements, not less than two hundred million gallons of water.

We ask whether this dam in design and location has ever had the approval of your Commission. We understand that it has not.

We also understand that the Palisades Interstate Park Commission claim to have exclusive jurisdiction in the premises; and if so it follows that,-

Regardless of the life and property placed in jeopardy by faulty construction of dams, reservoirs, overflows and other structures, they can construct as they may desire, and if the damage occurs, those damaged may have recourse to the Courts.

It is the opinion of the writer, unless he can be shown that the dam mentioned has had the approval of your Commission, that the same is very faulty in design; and not at all in accord with standard engineering practice; and that it is only a matter of short space of time when ice thrust against the narrow vertical wall, and other defects will rupture the structure and tear out any and all dams or other structures that may be below on the stream; with a probable great loss of life and property damage.

Unless the dam has been modified since last fall, the paved rip-rapped slope is on the down stream side on a steep slope from a point about ten feet from the top of the narrow top of concrete wall, vertical on the up-stream side, or with but a very slight batter; and concave in alignment down stream; and without up stream embankment or other protection.

We have included in our plans, as shown by Table 1, page 11, the following reservoirs on Stony Brook.

Saw Mill Bridge Res.	147	million gallons,	costing	$32,000.	
Junction reservoir	25	" "	"	35,000.	
Station J "	22	" "	"	12,600.	a
Station G "	17	" "	"	9,400.	b
				$89,000.	
Reserve storage, between Saw Mill Bridge reservoir and Junction reservoir, 150 million estimated to cost when constructed $600. per million =				60,000.	
				$149,000. *	

*Exclusive of power plant dam.

Or approximately $150,000. in value of construction (structural cost) is contemplated on this brook below where the Park Commission have or are about to construct dams and reservoirs, as above mentioned, and have in part so constructed them.

STATE OF NEW YORK—CONSERVATION COMMISSION

Complaint in re. dams on Stony Brook or tributaries in Haverstraw Twp., Rockland Co., N. Y. - Constructed or proposed by Palisades Interstate Park Commission. 3

J.W.H. Mar.19, 1918

MADE IN CONNECTION WITH Water Supply Appl'n 110,217 by Jos. P. Rider

REFERENCE Engr., in report dated Feb. 19, 1918, submitted Mar. 4, 1918, at page 29.

We feel that if it is true that your Commission have no jurisdiction over the location and design of dams that have been or may be constructed on Stony Brook by the Park Commission, that we are obliged, in order to protect our investment, and in order to insure a public water supply for fulfillment of our public contracts, to locate as much as possible of our storage away from said brook, and confine construction on said brook to the lowest possible minimum sufficient to divert and store the waters of said brook; for directly or indirectly we do not wish to be a party to injury, devastation and death that we feel is bound to occur if faulty designs for dams and reservoirs on this stream cannot be prevented by an appropriate, or your Commission."

DISPATCHERS FOR FIELD EMERGENCIES

In the event of serious forest fires or other emergencies, including unusual storms, deaths, and other emergencies, the appropriate Desk Sergeant, whose desk is manned on a 24-hour, 7-day basis, should be called.

The telephone number of the New York Desk Sergeant is 914-786-2701, while the number of the New Jersey Desk Sergeant is 201-768-1360.

The appropriate Desk Sergeant shall then call the following staff employees in the order listed:

New York Section	Office Telephone	Home Telephone
James W. Donnelly Chief of Patrol	914-786-2701	914-446-3570
Nash Castro General Manager	914-786-2701	914-359-5093
Donald B. Stewart Assistant General Manager	914-786-2701	914-446-3595
George L. Momberger Superintendent	914-786-2701	914-446-2072
New Jersey Section		
Richard G. Piper Chief of Patrol	201-768-1360	201-868-1546
Charles J. Quadri Superintendent	201-768-1360	201-768-3597
Nash Castro General Manager	914-786-2701	914-359-5093
Richard Olsen Assistant Superintendent	201-768-1360	201-768-6458

DISPATCHERS FOR FIELD EMERGENCIES - Continued

The staff person first apprised of the emergency by the Desk Sergeant shall communicate such information to the General Manager and Assistant General Manager as soon as practicable. The person, responsible above, shall also contact the proper personnel to handle emergencies in the best possible manner.

A REMINDER:

The Department of Transportation has asked that, in the event of emergency situations such as those which follow, we apprise them at number 914-454-8000 at any time of the day or night, seven days a week:

Failure of a segment of the transportation system such as a road closing or a bridge failure.

An accident resulting from a failure of a transportation facility.

An unusually severe accident resulting in injury or loss of life.

Serious construction accidents resulting in injury or loss of life.

Serious accidents involving transportation employees or equipment.

DISPATCHERS FOR FIELD EMERGENCIES - Continued

Floods, serious storms or natural disasters damaging our facilities or causing significant delays to the traveling public.

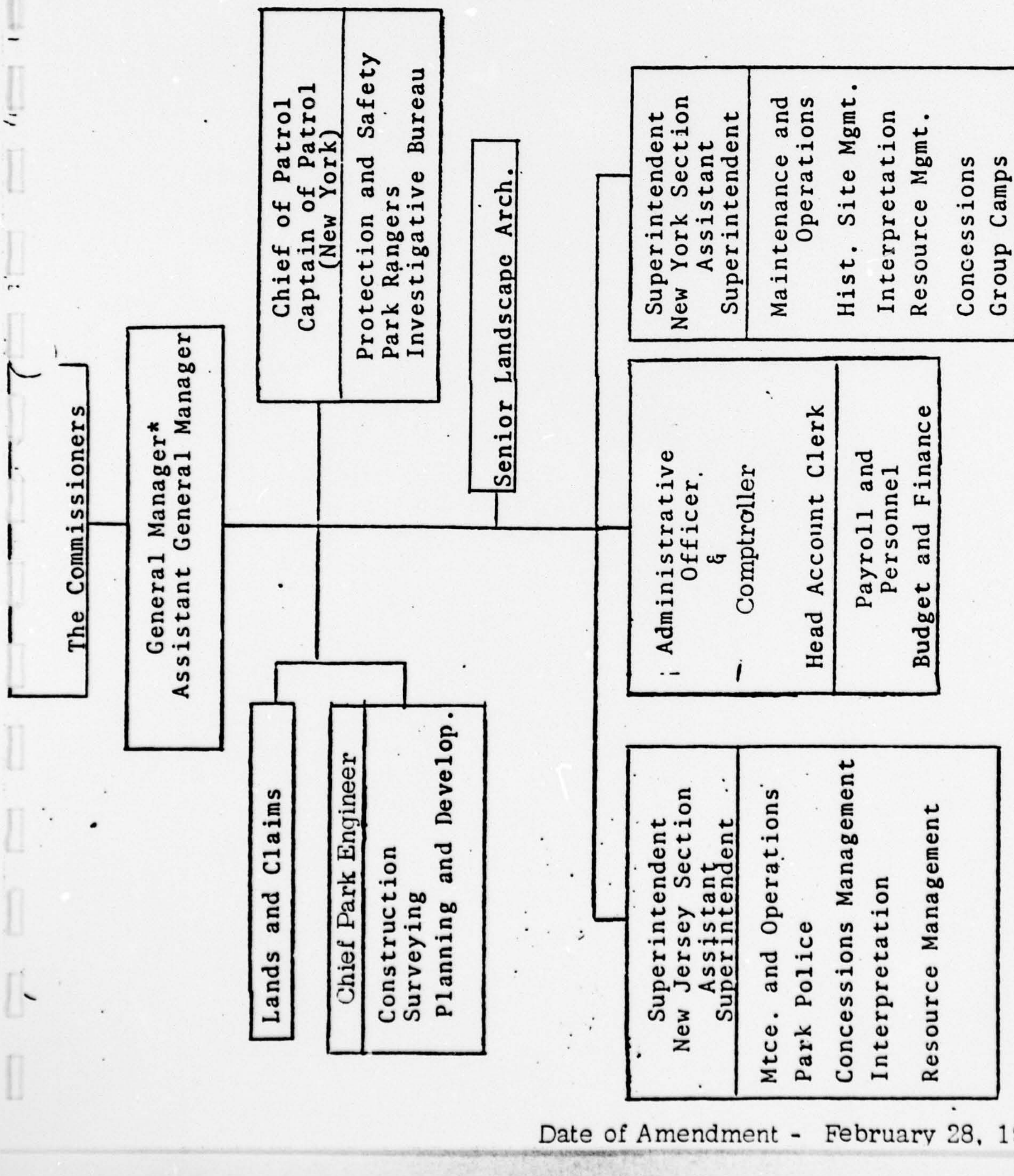
Unusual occurrences such as school bus accidents.

Unusual demands placed on transportation facilities.

Civil Disobedience involving transportation facilities.

Source: Letter from the Department of Transportation Regional Director, dated June 10, 1974.

ORGANIZATION CHART



* In addition to receiving supervision from the Commissioners of the Palisades Interstate Park Commission, the General Manager receives supervision, also, from the Commissioner of Parks and Recreation, State of New York, in respect to those matters relating to New York only.

AFTER HOURS TELEPHONE CONTACTS - ORGANIZATIONAL - Continued

Title	Name	Home Telephone No.
Office of Superintendent, New Jersey Section		
Superintendent	Charles J. Quadri	201-768-3597
Assistant Superintendent	Richard Olsen	201-768-6458
Police Chief	Richard G. Piper	201-868-1549
Maintenance Supervisor	Alexander Pinto	201-944-7528
Operations Supervisor	Cosmo Conserva	201-768-4112
Office of Chief Park Engineer		
Chief Park Engineer	John J. Troy	914-429-8282
Senior Park Engineer	Arthur C. Bruining	201-891-2723
Senior Park Engineer	Robert Santoro	914-237-5248
Park Engineer	Paul Sevik	914-446-4880
Park Engineer	Charles W. Tonneson	914-534-8773
Office of Administrative Officer		
Administrative Officer and Comptroller	James G. Taylor	914-534-8771
Head Account Clerk	Vacant	
Principal Account Clerk (Purchasing)	John J. Komonchak	914-446-3162
Land and Claims Office		
Assistant Land and Claims Adjuster	Vacant	

AFTER HOURS TELEPHONE CONTACTS - ORGANIZATIONAL - Continued

Title	Name	Home Telephone No.
Office of Chief of Patrol		
Chief of Park Patrol	James W. Donnelly	914-446-3570
Captain of Park Patrol	James B. Santoro	914-534-8253
Lieutenant Park Patrol - Northern District	Earl W. Sandstrom	914-928-6714
Lieutenant Park Patrol - Southern District	Raymond J. Mesaris	914-446-2466
Detective Sergeant	David P. Shea	914-786-3031
Historic Sites		
Regional Historic Preservation Supervisor	James P. Gold	914-876-4726

Date of Amendment - February 28, 1977

AFTER HOURS TELEPHONE CONTACTS - ALPHABETICAL

Name	Title	Home Telephone No.
Bruining, Arthur C.	Senior Park Engineer	201-891-2723
Castro, Nash	General Manager	914-359-5093
Conserva, Cosmo	Operations Supervisor, N. J.	201-768-4112
Cox, Ernest M.	Park Superintendent - Southern District	914-446-3710
Donnelly, James W.	Chief of Park Patrol	914-446-3570
Forman, Frank	Regional Park Maintenance Supervisor II	914-429-2143
Gold, James P.	Regional Historic Preservation Supervisor	914-876-4726
Herrington, A. E.	Park Superintendent - Bear Mountain	914-786-3013
Komonchak, John J.	Principal Account Clerk (Purchasing)	914-446-3162
Korbach, John	Photographer	201-278-5905
McCoy, David P.	Senior Landscape Architect	914-471-2952
Mesaris, Raymond J.	Lieutenant Park Patrol - Southern District	914-446-2466
Meybohm, Donald R.	Park Maintenance Supervisor II	914-786-5328
Momberger, George L.	Superintendent, New York	914-446-2072
Olsen, Richard	Ass't. Superintendent, N. J.	201-768-6458
Page, Roland R.	Park and Recreation Field Representative	914-759-2044
Pinto, Alexander	Maintenance Supervisor	201-944-7528
Piper, Richard G.	Police Chief, N. J.	201-868-1549

AFTER HOURS TELEPHONE CONTACTS - ALPHABETICAL - Continued

Name	Title	Home Telephone No.
Quadri, Charles J.	Superintendent, N. J.	201-768-3597
Quinn, Kieran	General Park Superintendent - Northern District	914-786-2489
Reid, John C.	Supervisor of Camp and Recreational Activities	914-429-5295
Sandstrom, Earl W.	Lieutenant Park Patrol - Northern District	914-928-6714
Santoro, James B.	Captain of Park Patrol	914-534-8253
Santoro, Robert	Senior Park Engineer	914-237-5248
Sevik, Paul	Park Engineer	914-446-4880
Shea, David P.	Detective Sergeant	914-786-3013
Stewart, Donald B.	Assistant General Manager	914-446-3595
Taylor, James G.	Administrative Officer and Comptroller	914-534-8771
Tonneson, Charles W.	Park Engineer	914-534-8773
Troy, John J.	Chief Park Engineer	914-429-8282

AD-A064 869 NEW YORK STATE DEPT OF ENVIRONMENTAL CONSERVATION ALBANY F/G 13/2
NATIONAL DAM SAFETY PROGRAM. LAKE KANAWAUKE DAM (NDS NY 58, NYS--ETC(U)
JUL 78 E A NOWATZKI, G S SALZMAN DACW51-78-C-0035

UNCLASSIFIED NL

2 OF 2
AD
A064869

END
DATE
FILMED
4-79
DDC

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
DAM INSPECTION REPORT
(By Visual Inspection)

Lake Kanawauke
Palisades Park Comm

Dam Number	River Basin	Town	County	Hazard Class*	Date & Inspector
353	L. Hudson	Haverstraw	Rockland	B	1/8/75 GE-KH

Type of Construction

- [ ] Earth w/concrete spillway
- [ ] Earth w/drop inlet pipe
- [ ] Earth w/stone or riprap spillway
- [x] Concrete
- [ ] Stone
- [ ] Timber

Use

- [ ] Water Supply
- [ ] Power
- [x] Recreation
- [ ] Fish and Wildlife
- [ ] Farm Pond
- [ ] No Apparent Use-Abandoned

Estimated Impoundment Size

- [ ] 1-5 acres
- [ ] 5-10 acres
- [x] Over 10 acres

Estimated Height of Dam above Streambed

- [ ] Under 10 feet
- [x] 10-25 feet
- [ ] Over 25 feet

Condition of Spillway

- [x] Service satisfactory
- [ ] In need of repair or maintenance
- [x] Auxiliary satisfactory
- [ ] In need of repair or maintenance

Explain: ______________________________

Condition of Non-Overflow Section

- [x] Satisfactory
- [ ] In need of repair or maintenance   Explain: ______________

Condition of Mechanical Equipment

- [x] Satisfactory
- [ ] In need of repair or maintenance   Explain: ______________

Evaluation (From Visual Inspection)

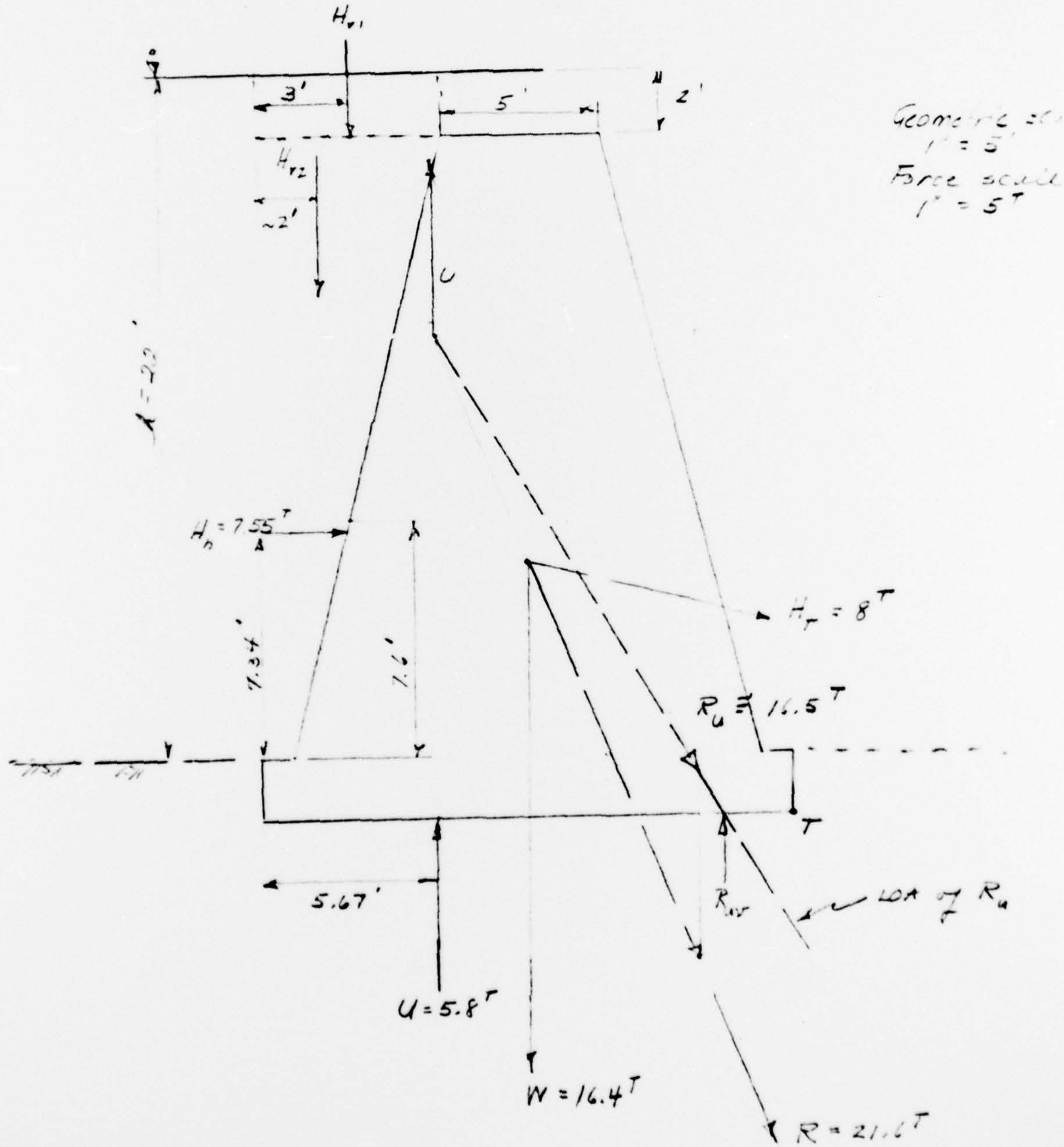
- [x] No defects observed beyond normal maintenance
- [ ] Repairs required beyond normal maintenance

*Explain Hazard Class, if Necessary ______________

APPENDIX F

STABILITY COMPUTATIONS

Assume trapezoidal section 20' high on 17' wide pedestal foundation 2' thick.
Assume flow over spillway when pool is at elevation 829.7 (seat elevation of abutment) and no tailwater.



Y Sthl DATE 6/14-20/78 **JOSEPH S. WARD** SHEET NO. 2 OF 9

HKD. BY JSO DATE 6/27/78 91 ROSELAND AVE. CALDWELL, N. J. JOB NO. A7805-11

SUBJECT Stability Analysis - Lake Karuwaukee Dam

Gravity & Hydrostatic Forces

$W = 140 \frac{lbs}{ft^3} \times 1 ft \times \left[\left(\frac{5+15}{2}\right) 20 ft^2 + 17 \times 2 ft^2 \right] = 32760 \#$

$\boxed{W \doteq 16.4^T}$

$H_h = \frac{1}{2} \gamma_w h^2 = \frac{1}{2} 62.4 \frac{lb}{ft^3} (22 ft^2) \, 1 ft \doteq 15100 \#$

$\boxed{H_h = 7.55^T}$ acting as shown on p 1.

$H_{v1} = [6 ft \times 2 ft \times 1 ft] 62.4 \frac{lbs}{ft^3} \cong 750 \text{ lbs} \approx 0.38^T$ acting as shown.

$H_{v2} \doteq \left[\frac{6+1}{2}\right] ft \times 20 ft \times 62.4 \frac{lbs}{ft^3} \, 1 ft = 4368 \text{ lbs} \doteq 2.18^T$ acting as shown

$\boxed{H_{vT} \doteq 2.56^T}$

$H_T = \sqrt{7.55^2 + 2.56^2} = 7.97^T \cong 8^T$

$\boxed{H_T = 8^T}$

$7.33 H_h + 3 H_{v1} + 2 H_{v2} = x H_T$

$7.33(7.55) + 3(0.38) + 2(2.18) = 8x$

$x \doteq 7.6'$

Assume resultant hydrostatic force acts 7.6' from top of pedestal perpendicular to upstream face of dam.

Uplift Forces

Since there is no indication that foundation rock has been sealed, assume full hydrostatic uplift pressures act.

$\left.\begin{array}{l} u_1 = 62.4 \frac{\#}{ft^3} \times 22' \\ u_2 = 0 \end{array}\right\}$ triangular distribution

$U = \frac{1}{2} 62.4 \frac{lbs}{ft^3} \times 22 ft \times 17 ft \times 1 ft \doteq 11670 \text{ lbs}$

$\boxed{U \doteq 5.8^T}$ acting as shown

BY SFN DATE 6/20/78 | JOSEPH S. WARD | SHEET NO. 3 OF 9
CHKD. BY JSC DATE 6/27/78 | 91 ROSELAND AVE. CALDWELL, N. J. | JOB NO. A7805-11

SUBJECT Stability Analysis - Lake Kanawauke Dam

Overturning Stability

Overturning Moments about point T

$7.55^T(9.34') + 5.8^T(17-5.67) = 136.2^{T\text{-ft}}$

Resisting Moments about point T

$16.4^T(17/2) + 0.38^T(17-3) + 2.18^T(17-2) = 177.4^{T\text{-ft}}$

$\boxed{FS = \frac{177.4}{136.2} = 1.3}$ $\therefore$ ok

Sliding Stability

Actuating Force $= H_h = 7.55^T = AF$
Resisting Force $= (W + H_{vT} - U)\mu = RF$

Assume $\mu = 0.65$

$RF = 0.65(16.4^T + 2.56^T - 5.8^T) = 8.55$

$FS = \frac{8.55}{7.55} = 1.13$

Actually FS > 1.13 since embedment of foundation was neglected in computation $\therefore$ OK

$\boxed{FS > 1.13}$ $\therefore$ OK

Compressive Stress

Vertical Component of $R_u \cong 14.1^T = R_{uv}$
Assume it acts at base as shown. Distance from toe is about 2.25'. Therefore max stress (assuming triangular distribution) is:

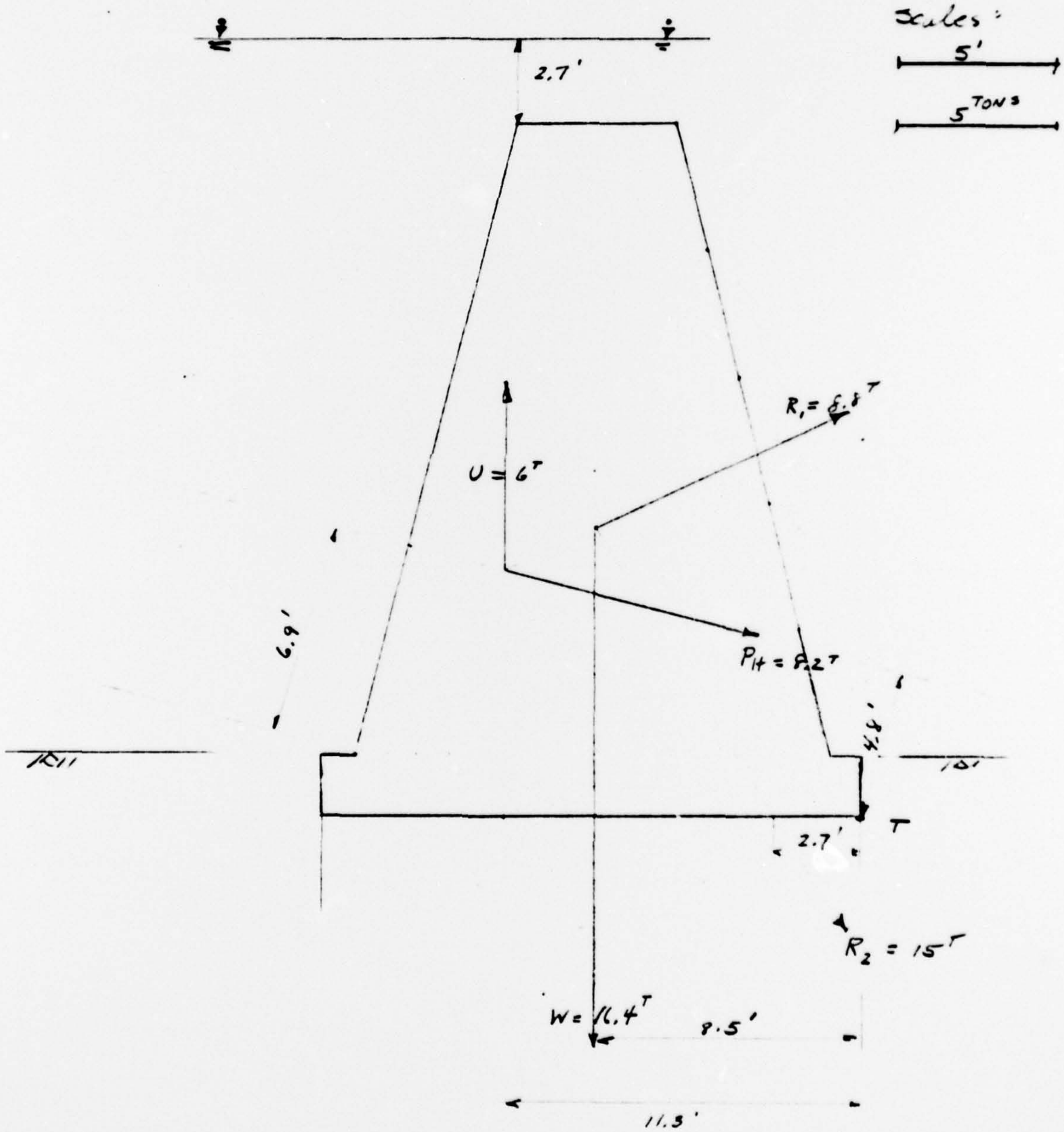
$R_{uv} = \frac{1}{2}\sigma(2.5 \times 3) = 14.1^T$

$\sigma = 3.76$ tsf << compressive strength of granite rock which is $\cong$ 150 tsf

$\therefore$ OK

SUBJECT Lake Kanawauke - Stability Analysis - 2.7' Overflow

Assume trapezoidal section 20' high on 17' wide pedestal foundation 2' thick.
Assume PMF flow over spillway (pool at Elevation 830.45), no effect from wooden walkway and no tailwater
Height of water over crest = 830.45 - 827.75 = 2.7'



Hydrostatic Forces

$p_1 = 2.7\,ft\,(62.4\,pcf) = 168.5\,psf$
$p_2 = 22.7\,ft\,(62.4\,pcf) = 1416.5\,psf$

$$P_H = \left(\frac{168.5 + 1416.5}{2}\right)\sqrt{20^2 + 5^2} = 16338 \text{ lbs/ft} \cong 8.2\ ^T/ft$$

Assume P_H acts $\perp$ to upstream face 1/3 the way up from top of pedestal ($20.6/3 \cong 6.9'$). $P_{HH} = 8.2 \cos 14^\circ \cong 8.0\ ^T/ft$
$P_{HV} = 8.2 \sin 14^\circ \cong 2.0\ ^T/ft$

Uplift Forces
Assume full uplift pressure

$$U = \tfrac{1}{2}(62.4\,pcf) \times 22.7\,ft \times 17\,ft = 12040\ lb/ft \cong 6.0\ ^T/ft$$

Weight

From previous computation $W = 16.4\ ^T/ft$

$R_1 = \overrightarrow{U + P_H} = 8.8\ ^T/ft$
$R_2 = \overrightarrow{R_1 + W} = 15\ ^T/ft$; $R_{2V} \cong 12.6\ ^T/ft$

Overturning Stability

Moments about toe (T)

$8.2^T(4.8') + 6^T(11.3') = 107.4\ ^{T}ft$ overturning
$16.4^T(8.5') = 139.4\ ^{T}ft$ resisting

$FS = \dfrac{139.4}{107.4} \cong 1.3$ OK

Sliding Stability

Actuating force $= P_{HH} = 8.0\ ^T/ft$
Resisting force $= \mu(W + P_{HV} - U) = 0.65\,(16.4 + 2 - 6) = 8.06$

$FS = \dfrac{8.06}{8.0} \cong 1$

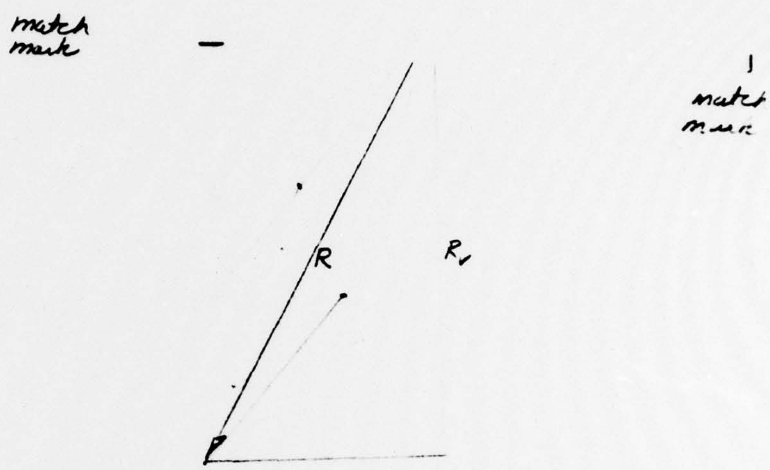
Actual FS > 1 since effect of foundation embedment in rock was neglected. - OK

Compressive Stress

OK - $R_{2V} = 12.6 = \tfrac{1}{2}\sigma(2.7 \times 3)$; $\sigma = 3.1\ tsf \lll \sigma_{rock} \cong 50$

BY: EAN DATE: 7/7/78
CK'D BY HDD 7/10/78

Sheet 6 of 9
Job # A7805-11



BY EMN DATE 6/21/78 | **JOSEPH S. WARD** 91 ROSELAND AVE. CALDWELL, N. J. | SHEET NO. 7 OF 9
CHKD. BY ISO DATE 6/27/78 | JOB NO. A7805-11
SUBJECT Stability Analysis - Lake Kanawauke Dam - Ice Condition

Consideration of stability with lake frozen over (ice thickness = 18 inches). Consider effects of solar energy absorption and assume no lateral restraint. Also assume an air temperature change rate of 10°F/hr.

Thrust $\cong$ 6000# = 3T = T_I

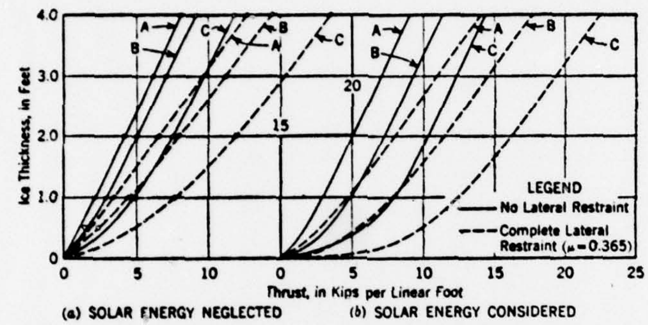
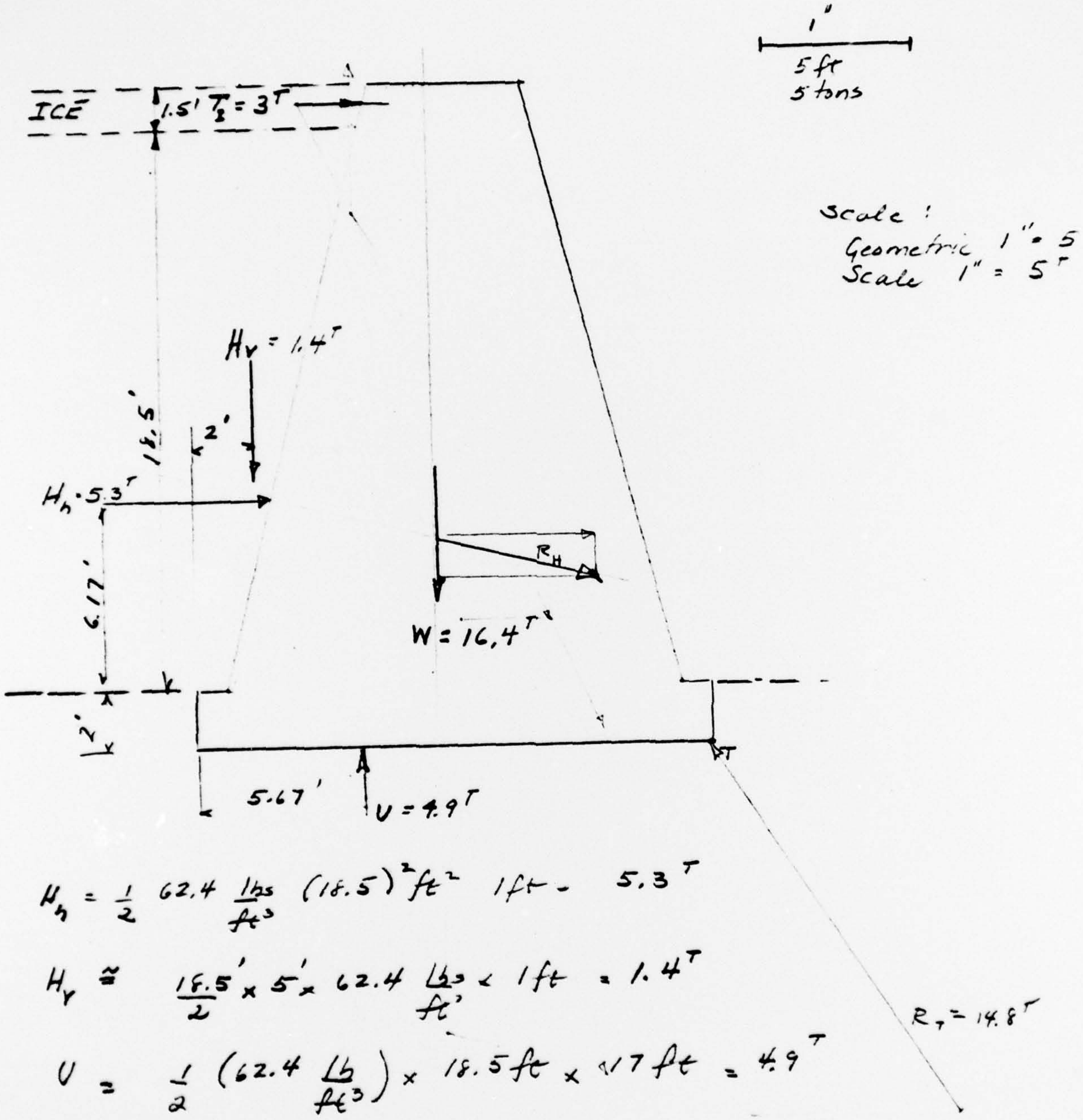


FIG. 2.—ICE THRUSTS FOR THE VARIABLES, ICE THICKNESS, AIR-TEMPERATURE RISE, AND RESTRAINT

(From E. Rose (1947), "Thrust Exerted by Expanding Ice Sheet," Transactions ASCE, Vol. 112, pp 871-900.

A = 5°F/hr
B = 10°F/hr
C = 15°F/hr



$$H_h = \frac{1}{2}\ 62.4\ \frac{lbs}{ft^3}\ (18.5)^2 ft^2\ 1ft = 5.3^T$$

$$H_V \cong \frac{18.5'}{2} \times 5' \times 62.4\ \frac{lbs}{ft^3} \times 1ft = 1.4^T$$

$$U = \frac{1}{2}\left(62.4\ \frac{lb}{ft^3}\right) \times 18.5 ft \times 17 ft = 4.9^T$$

Stability

1) Against overturning

Overturning moments

$5.3^T(8.17') + 3^T(21.25') + 4.9^T(11.33') = 162.6^{Tft}$

Resisting moments

$16.4^T(8.5') + 1.4^T(15') = 160.4^{Tft}$

$\boxed{FS = 0.99 \approx 1.0}$

Estimate of ice thrust force is conservative, therefore FS > 1. OK

2) Against sliding

Actuating force $= H_h + T_I = 5.3^T + 3^T = 8.3^T$
Resisting force $= \mu(W + H_v - u) = 0.65(16.4^T + 1.4^T - 4.9$
$= 8.4^T$

$\boxed{FS = \frac{8.4}{8.3} \cong 1}$

Estimate of ice thrust force is conservative - OK.

3) Compressive stress

Assume R_T acts 1/3 foot inside toe
$R_{TV} = 12.5^T$

$12.5^T = \frac{1}{2}\sigma(1')(1')$

$\sigma = 25$ tsf, still < 50 tsf ∴ OK.

APPENDIX G

GEOLOGY

APPENDIX G

GEOLOGY

Lake Kanawauke Dam

1. General Geology

The damsite and reservoir lie in western Rockland County, adjacent to the Orange County line.

The bedrock consists of undifferentiated Pre-Cambrian hornblende granite and granitoid gneiss, hornblende gneiss, and rusty paragneiss including biotite-quartz-plagioclase paragneiss, marble, calc silicate rock, all with characteristic pyrite and graphite.

Structurally, the area is in a complex of folded formations; the lake and dam are located in a synform which plunges to the northeast. There are normal fault lines to the west and north of the damsite.

Geologically, the area is part of the Hudson Highland portion of the Reading Prong.

2. Site Geology

Air photo interpretation detected the apparent old scars of minor landslide activity in the general vicinity of the site. Lake Kanawauke was apparently formed in a synclinal trough. A normal fault intersects the lake at the extreme north end. The Ramapo fault passes approximately 3.7 miles east of the dam. Soil cover on the lake slopes appears shallow (probably less than 5'). The dam is very near the contact between a hornblende gneiss and a paragneiss.